

NOVEMBER 2011

MOUNTING SPACE DEBRIS

PG 42

BIRD MIGRATION PG 34

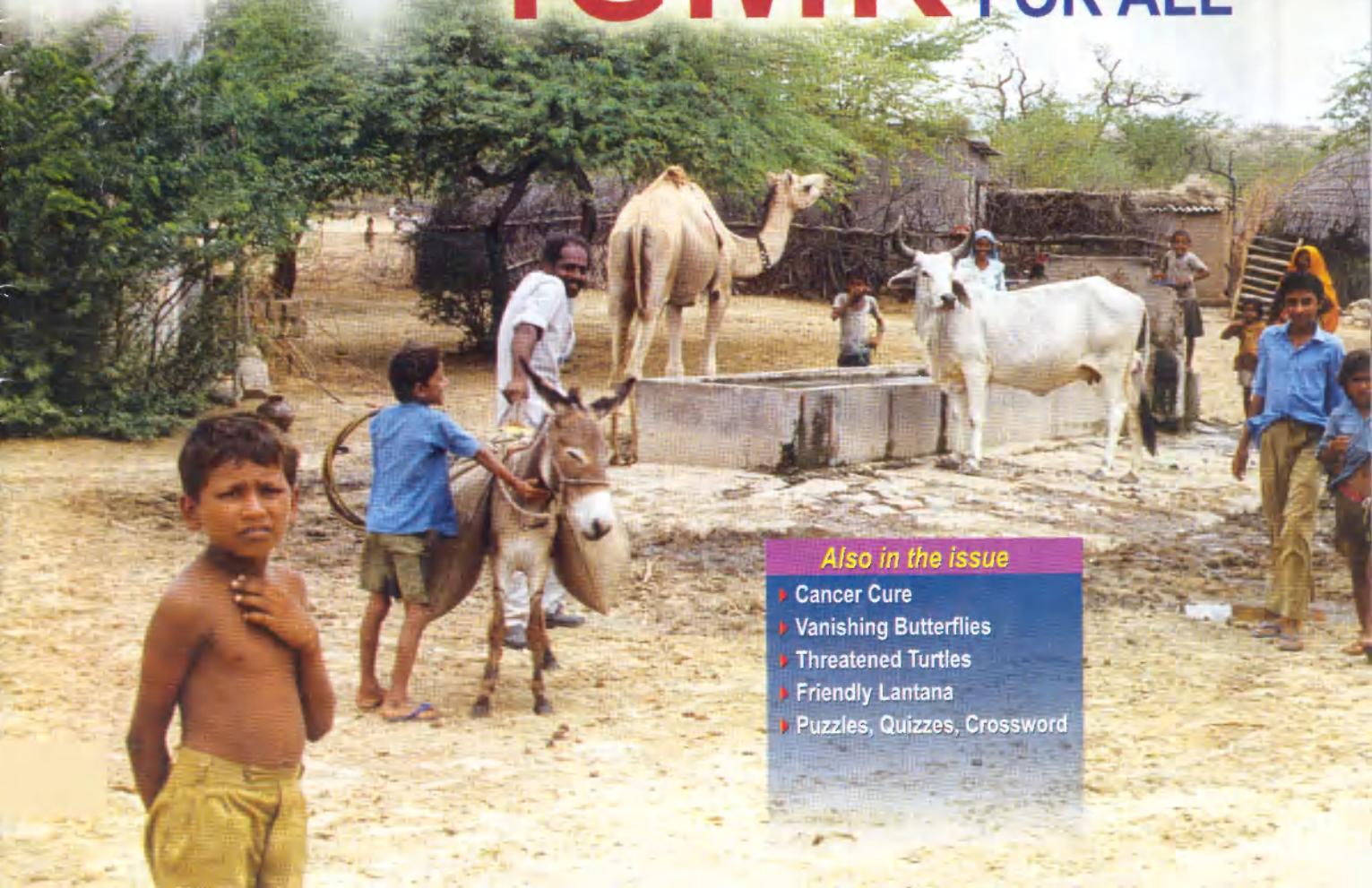


Science Reporter

A CSIR PUBLICATION

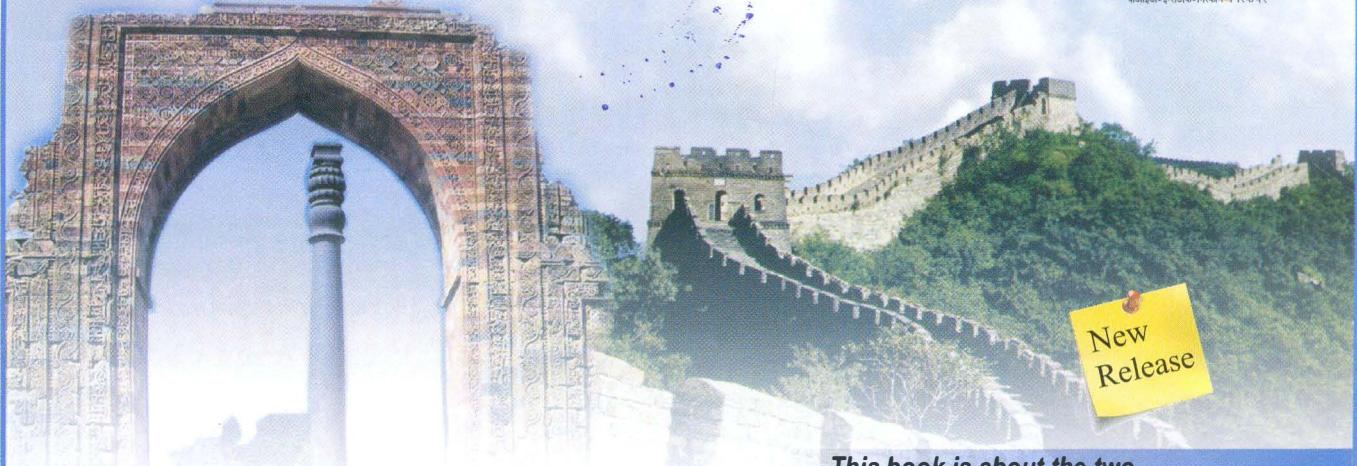


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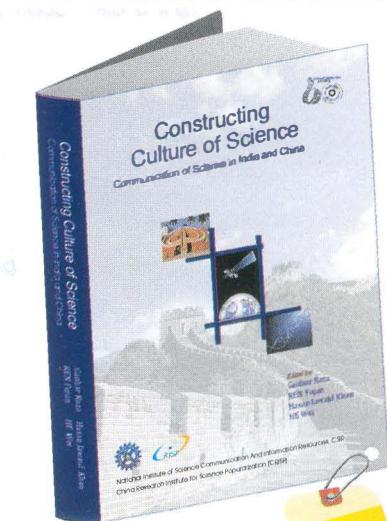
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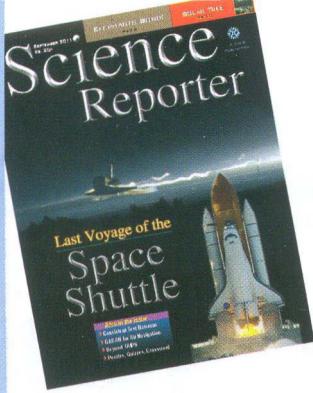
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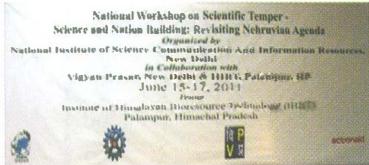
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BUILDING UP SCIENTIFIC TEMPER

Thanks for publishing a report on the National Workshop on Scientific Temper under the title **The Age of Reason** by Archita Bhatta in your August Issue. I found the information on taking up a national survey for measuring the scientific temper



in the country quite interesting and thought provoking. I would like to add a few points on this subject.

To build a scientific temper it seems establishment of a strong supporting system/environment both physical and manual is necessary. For example, to maintain faith in scientific health care procedures/systems the linkages among the rural/intermediate/super specialty hospitals should be very smooth and the persons managing the affairs should be well trained as well as humane. Even if a patient does not recover from his illness despite scientific approaches clarified to the relatives of the patient, grievances should not lead to frustration and get translated into faith on talisman, *bibhutis*, holy-dips, with craft etc.

It requires little elaboration that the building up should start from student life so that when these students start earning their livelihoods scientific

temper will guide them to produce/maintain a pleasant living condition.

Building up scientific temper should aim at generating faith in man's talent, industry, and enthusiasm rather than on miracles. Many established persons in various fields are found to display their faith in extra-terrestrial origins, which destroys the very efforts they have made to build up their careers. A society consisting of a large number of people with good scientific temper will certainly be more happy and prosperous.

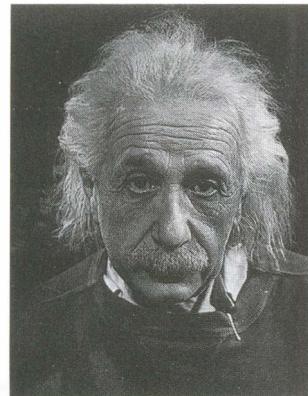
I will be looking forward to later developments on this subject and will hope Science Reporter will feed us with reports from time to time.

Swapan Bhattacharya

West Bengal

FASTER THAN LIGHT

In an experiment dubbed "OPERA", CERN scientists have reported that measurements taken over a three-year period showed that neutrinos pumped from CERN near Geneva to Gran Sasso in central Italy had



arrived 60 nanoseconds faster than light which would have taken around 2.4 thousandths of a second. Neutrino particles that move faster than light confirms the hypotheses put forward many years ago by Tesla and also "tachyons", postulated by Dr. E.C.G. Sudarshan. In the early 1970s, I was fortunate enough to listen to his lecture delivered in the

Physics Department of MCC, Tambaram. His faster than light particles or "tachyons" however were cosmic particles that were always traveling faster than light and could not slow down to speeds below that of light or cross the light barrier.

Quantum physics would certainly have to be reviewed in the light of the CERN discovery because the particles from the collider were man made. Perhaps in the future, humankind may exploit these neutrino particles for super fast communications, super cybernetic tools and extra intelligent cyborgs. That is, till we find out ways and means of making neutrinos interact with matter.

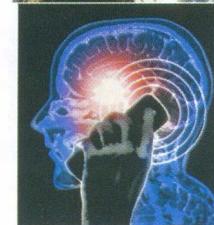
Haridas Panicker

Kerala

Email: omharisai@gmail.com

TECHNO CONCERN

In the August 2011 issue, the editorial, **Are You a Techno Addict?**, was significant. It is a



pity that technology, which is a boon for today's world, is nowadays a matter of concern.

The article **Megaton to Megawatt** by M.S.S. Murthy was also very interesting. I am really grateful to SR for publishing such a lucid and informative piece.

Chinmoy Haloi

Class 10, Sudershan Public School, Khanapara, Guwahati.

SAVING THE FORESTS

Being a regular reader of Science Reporter I convey my warm gratitude for publishing the excellent cover story **Saving the Saviors** in the June issue in the light of the



International Forest Year. We are always busy trying to come up with new and improved technologies so that we can live happily and as such deforestation never bothers us. Forests are cleared whenever there is need to build multistoried buildings and factories. It is not too late yet. We have to raise our voice to save the forests.

The article, **Care For Your Eyes Naturally**, published in the September issue was undoubtedly a rare and informative article with regard to a vital organ of the body. Mostly we do not care much about our eyes causing it to get damaged.

Debasis Ghosh

Barrackpur (West Bengal)

WE WOULD LIKE TO HEAR FROM YOU

If you have any comments about any article published in Science Reporter, or have some information to share with our readers, do write to us at:

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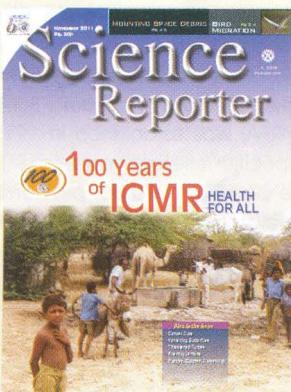
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GAUGING SCIENTIFIC LITERACY

How can a functioning democracy be further strengthened? Of course, zero tolerance to corruption and corrupt leaders is a must. A literate population is equally imperative. But a major subset of literacy is scientific literacy. A high scientific literacy rate is important for today's technologically driven society. Scientific literacy is especially of paramount significance in a nation that is counted among the fastest growing economies and that has a rapidly burgeoning population, the majority of it concentrated in villages and remote and underdeveloped areas.

And what does scientific literacy imply? In simple terms, it means that a person should be able to ask questions, or determine answers to questions, derived from everyday experiences. The person should have the ability to seek explanations to natural phenomena rather than merely accepting passed down judgments or accepting them as some sort of miracles. Scientific literacy also entails being able to understand articles about science in the popular press, identify scientific issues of national importance and evaluate arguments based on evidence. The person should be able to take informed decisions and express positions that are scientifically and technologically informed.

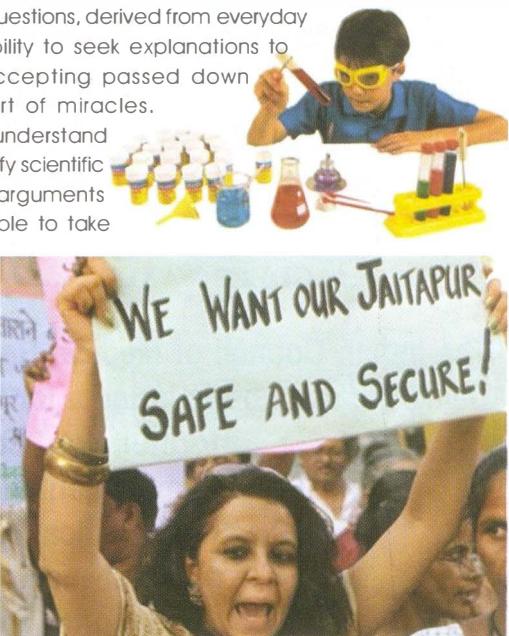
So, what is the status of scientific literacy in India's population? We do not have the numbers. In fact, hardly any nationwide effort has been made to gauge the level of scientific literacy among the citizens of our country. A country like China, on the other hand, one with which we are always comparing ourselves, has been conducting public scientific literacy surveys for the past 20 years and using the data to compare China with other countries.

In fact, most recently, according to a national survey on scientific literacy by the China Association for Science and Technology (CAST), only 3.27% of respondents had basic scientific knowledge in 2010, which is on par with the level of developed countries and regions in the early 1990s. In other words, only about three per cent of Chinese adults surveyed meet the level of scientific literacy needed to understand scientific terms, concepts and methods, and the impact of science on society. The results show that scientific literacy is growing at a worryingly low pace — up from two to three per cent in the decade since 2001. The dismal results of the survey have goaded China into focusing on improving the overall scientific knowledge of Chinese people during the period of the 12th Five-Year Plan (2011-2015).

India, which shares a similar trajectory with China, also needs to gauge the level of understanding of science and related issues of its citizens. Regular and nationwide scientific literacy surveys are a must for a country the size of India and one that is eager to join the ranks of the superpowers. Such surveys will not only bring to light scientific issues and concerns that most befuddle the Indian populace but will also help to identify target populations most in need of awareness about scientific issues.

With more and more mega projects with huge scientific components increasingly facing the ire of the public, the surveys might also help to work out new methodologies to communicate pertinent issues about technologies and projects that seem to very soon assume "controversial" proportions.

Hasan Jawaid Khan



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100 Years of ICMR!



100 Years in the Service of the Nation
(1911-2011)



JAGDEEP SAXENA & V.K. SRIVASTAVA

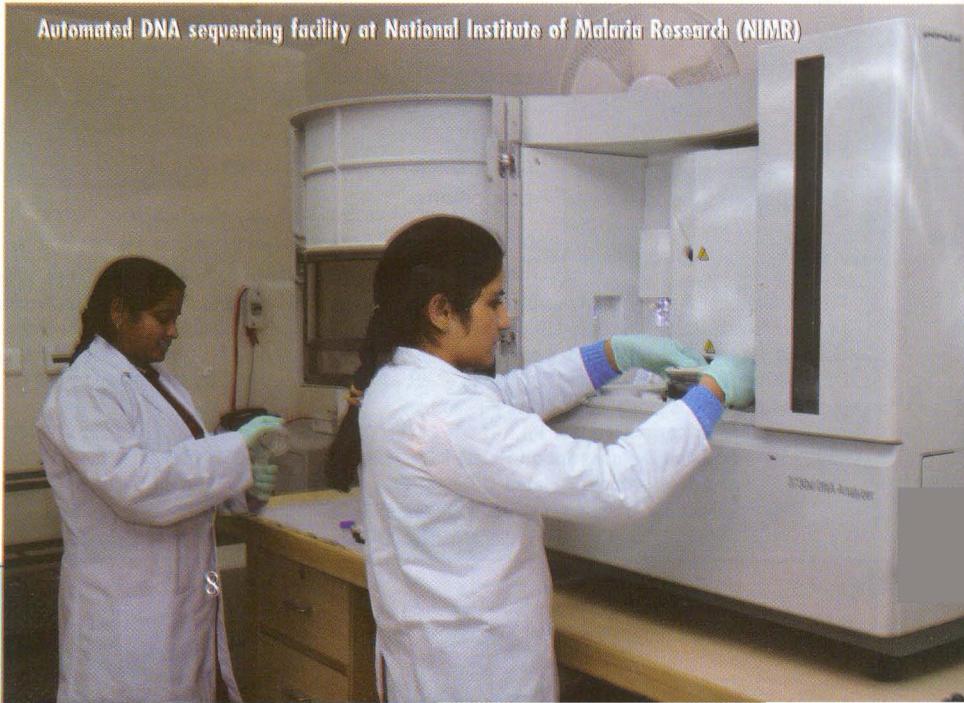
The Indian Council of Medical Research (ICMR), New Delhi, the apex body in India for the planning, formulation, coordination, implementation and promotion of biomedical research, is one of the oldest medical research bodies in the world. Today, it is 100 years old and enjoys a pan-India presence with 31 dedicated research institutes and centres across the major disciplines.

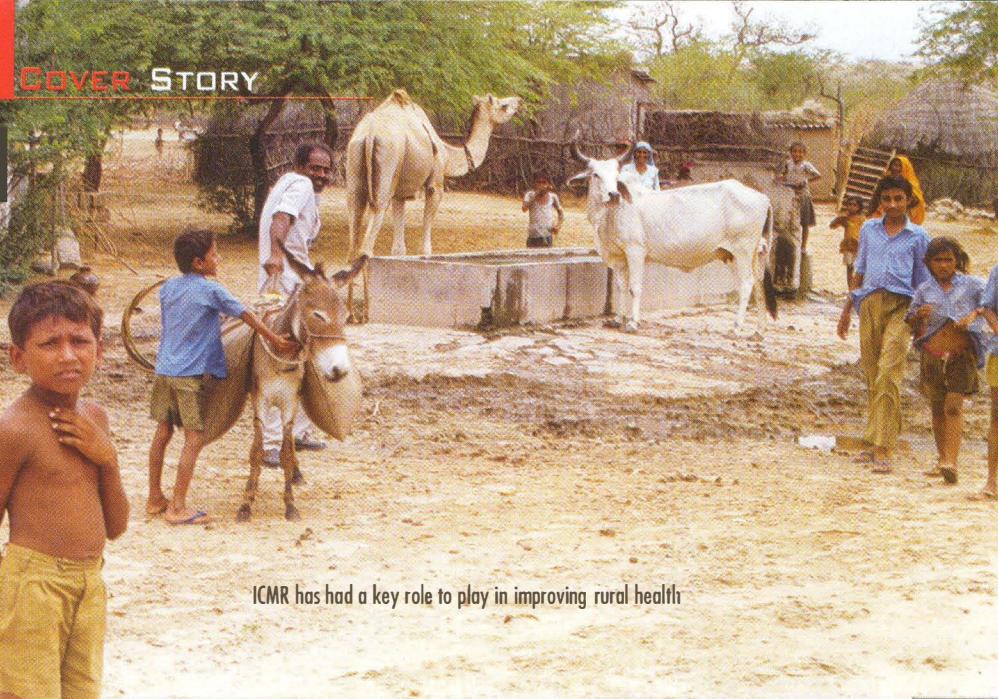
ABOUT a hundred years ago, persistently declining population of undivided India was an issue of utmost importance and concern for British policy planners. Due to incessant famines and widespread epidemics, the death rate was exceedingly high at that time. Ironically, today India is struggling hard to stabilize its rapidly increasing population, which is a recognized constraint in the otherwise astounding development saga of the country.

Ironically, again, the rapidly increasing population of the country is due to breakthroughs in medical research, conducive policy interventions, and healthcare infrastructure. Today, an average Indian enjoys a life expectancy of 66.8 years at birth. Life expectancy at birth is a measure of the overall quality of life and can also be thought of as indicating potential return on investment in human capital.

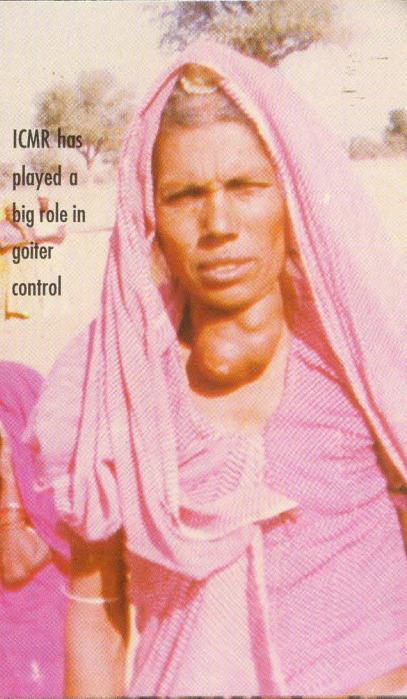
Besides, medical research in India has not only saved countless lives but has also led to innovations that are today being utilized across the world.

Automated DNA sequencing facility at National Institute of Malaria Research (NIMR)





ICMR has had a key role to play in improving rural health



ICMR has played a big role in goiter control

ICMR could successfully implement the Oral Rehydration Therapy in the 1970s, which drastically reduced the mortality rate of cholera.

the oldest medical research bodies in the world, preceding even the British Medical Research Council. After independence, the IRFA was redesignated as the Indian Council of Medical Research (ICMR) with considerable expanded scope of functions.

With a modest beginning in 1911, today ICMR enjoys a pan-India presence with 31 dedicated research institutes/centres across the major disciplines. ICMR's institutes are addressing themselves to research on specific areas such as tuberculosis, leprosy, cholera and diarrhoea, viral diseases including AIDS, malaria, Kala-Azar, vector control, nutrition, reproduction, immunohaematology, oncology, medical statistics, etc.

Regional Medical Research Institutes have been established to address regional health problems and also strengthen or generate research capabilities in different geographical areas of the country. ICMR also has Research Units or Centres to conduct research on specific problems, such as food and drug toxicology, viral diseases, handling micro-organisms of highly infectious nature, prenatal diagnosis for neonatal retardation etc. and supply of various animal models and feeds for experimental purposes.

Apart from conducting research, the Council also promotes and supports independent Extramural Research, through Centres for Advanced Research, task force studies and ad-hoc, open-

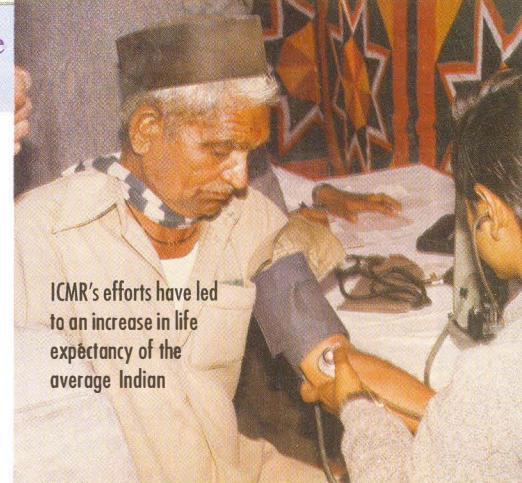
ended research schemes. Each of these has a different focus and works in a different manner.

Tackling Cholera, Diarrhea and Malaria

The high morbidity and mortality associated with classic cholera made it one of the most feared diseases of the 19th century. Despite several noteworthy accomplishments, diarrhoeal disease is one of the leading causes of illness and death in young children particularly in developing countries. Global deaths from diarrhea in children below five years of age are estimated to be approximately 1.87 million, annually. India alone contributes about 20% of all global under-five diarrhoeal deaths.

ICMR could successfully implement the Oral Rehydration Therapy (ORT) in communities and hospitals in the 1970s, which drastically reduced the mortality rate of cholera. ICMR scientists also discovered a highly virulent epidemic strain of *Vibrio cholerae* of a novel serotype O139 that caused major cholera outbreaks in India and Bangladesh during the 1990s.

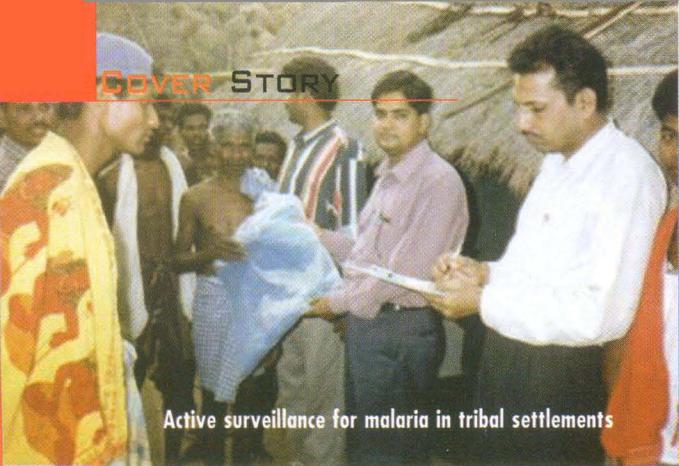
ICMR is also providing technical inputs to information programmes designed for mothers and supplemental training for health care providers emphasizing the importance of ORT, increased fluid intake, continuing feeding including breast feeding, zinc supplementation and



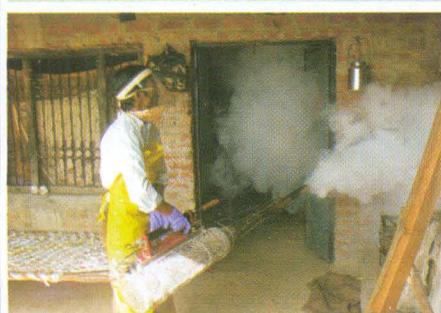
ICMR's efforts have led to an increase in life expectancy of the average Indian

discouraging indiscriminate use of drugs in treating childhood diarrhea. If ORT and other sound diarrhea management measures are administered early and correctly, mothers could prevent up to 90% of diarrhoeal deaths. Zinc supplementation combined with correct use of ORT can reduce the child's chance of death by 50%. Research findings of ICMR's National Institute of Cholera & Enteric Diseases, Kolkata are recognized the world over.

Modern research on malaria can rightly be said to have begun with the milestone discovery of Sir Ronald Ross who exposed the role of the female mosquito in the transmission of malaria and laid the foundation for malaria research and its control in 1897 (he won the Nobel prize for his research). Prior to this, malaria had been thought to be associated with harmful vapours that arose from marshes and stagnant water.



Active surveillance for malaria in tribal settlements

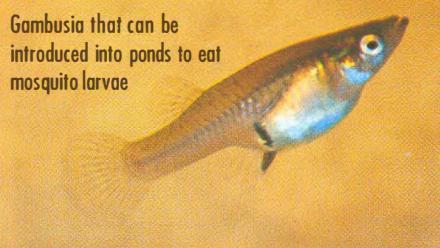


Spraying of insecticides for control of adult mosquitoes

Larvivorous fish ready for release into the breeding habitats



Gambusia that can be introduced into ponds to eat mosquito larvae



cases in 1976. In response to the challenge of re-emergence of malaria, ICMR reviewed the malaria situation and identified priority areas of research. Time bound research projects in specific fields of malaria were funded from the extra-mural grant of ICMR.

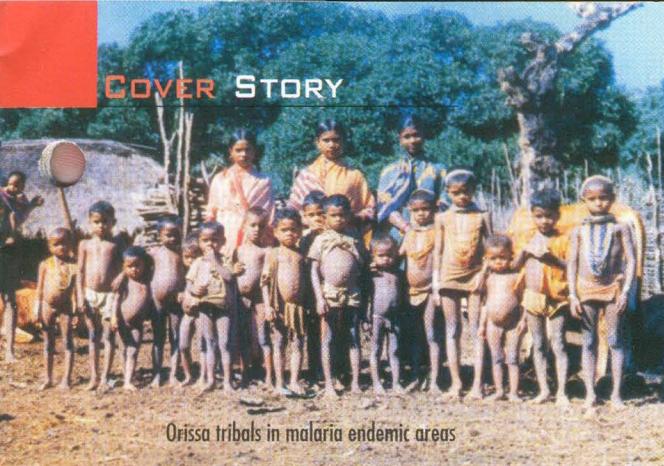
Without any further delay, in the same year, ICMR established the Malaria Research Centre (MRC) in Delhi with the objective of conducting basic and applied research, undertaking field research in Malariology and helping to develop trained manpower in the country. Upgraded as the National Institute of Malaria Research, it has played a vital role in controlling malaria in some of the severely affected regions of the country such as Betul in Madhya Pradesh, Vishakhapatnam in Andhra Pradesh, and Nainital in Uttarakhand.

Curtailing Deformities

Crippling poliomyelitis could attract attention of the general public, medical faculty and the public health authorities only in the year 1949 when it broke out in an epidemic form in and around the city of the then Bombay. IRFA immediately swung into action by establishing a Polio Research Unit in the metro with an allocation of merely Rs. 12070/-

The Polio Research Unit is credited with the introduction of the oral poliovirus vaccine (Sabin) in India. In 1961, oral poliovirus vaccine trial was undertaken in three districts of Andhra Pradesh using vaccine imported from USSR and Canada. Over 120000 doses of OPV were administered in one week. This trial was followed by OPV administration in Gujarat, Rajasthan and Bombay. After the successful trials in Andhra Pradesh the demand for OPV increased progressively.

Gradually, the Unit was upgraded as the Enterovirus Research Centre in 1981 and, seven years later, the World Health Organization declared global polio



Orissa tribals in malaria endemic areas

Malaria Research Centre was established in Delhi with the objective of helping to develop trained manpower in the country.

Modern research on malaria can rightly be said to have begun with the milestone discovery of Sir Ronald Ross who exposed the role of the female mosquito in the transmission of malaria.

eradication. The Centre has contributed significantly to initiation of the vaccination against poliomyelitis, polio vaccine production and introduction of newer formulations of the vaccine to address the remaining issues in the last stages of polio eradication. The Centre has been in the forefront in documentation of progress of polio eradication in India through various scientific investigations. Currently the Centre focuses on developing strategies to ensure that polio eradication in India is complete. These include disease surveillance requirements and maintaining high population immunity in the post-eradication era.

Until the late 1940s, leprosy patients were treated with Hydrocarpus (Shaulomoogra) oil derivatives all over the

world. This treatment did sometimes produce good results, but it had its own limitations. The effectiveness of this treatment was inconsistent, which ultimately discouraged medical researchers to go ahead. With the introduction of sulphones in the treatment of leprosy, interest in the problem was revived.

IRFA aided many enquiries that led to the working out of treatment schedules with the commonly used sulphone drugs. The response of different types of leprosy to the sulphone drugs was also investigated. The results were very encouraging. ICMR therefore first recommended the use of sulphones not only for treatment, but also for checking the spread of infection, based on the

observation that in all the patients treated, there occurred a gradual reduction in the bacterial content. The Council has an institute called the National JALMA Institute for Leprosy & Mycobacterium Diseases located at Agra.

Nutrition for Health

ICMR has played a key role in the development of public health activities in the country, in the field of nutrition. Research efforts of the Council almost eliminated the first vitamin deficiency disease called Beriberi from the country in the late fifties with a simple intervention: 'use a varied diet, do not restrict the diet too rigidly to machine milled rice'.

Similarly, ICMR studies busted the Protein Energy Malnutrition myth convincingly. Studies of pre-school children were made to gauge their energy and protein intakes. It indeed turned out to be a surprising revelation that the protein concentration of their diets was nearly adequate contributing to about 10% of their energy. However, the average energy intake was grossly deficient. This analysis paved the way for a new hypothesis that the malnutrition among underprivileged children was due to energy deficiency and not solely due to protein deficiency, thus busting the protein myth. Large-scale community studies were initiated to test this hypothesis and the view was soon endorsed by United Nations organizations like WHO and UNICEF.

Iron deficiency leading to nutritional anemia is most frequently encountered among the malnourished population of India. After a series of studies on the stability and bioavailability of iron in common salt



Social mobilization for filariasis control



Reimpregnation of bednets

Despite substantial progress made on many fronts, there are still areas of concern. Maternal and Infant Mortality are still unacceptably high in several areas, infectious diseases continue to remain a threat to public health.

fortified with iron employing different iron compounds and wide range of stabilizing agents, a successful process for fortification of salt with iron was developed. At present, technologies of double fortified salt (DFS) and fortification of wheat atta with iron and other essential nutrients have been transferred to industries.

In yet another important development, studies on administration of massive dose of vitamin A to avoid nutritional blindness among children, paved the way for a nation-wide vitamin A prophylaxis programme with its inclusion in the Fourth Five-year plan. The ICMR had also evaluated the National Anemia Prophylaxis Programme and the shortcomings of the programme were brought out. Similarly, studies on goiter control programmes in coastal Andhra Pradesh established that there was irregular supply of iodized salt, lack of iodine content in salt and absence of quality control measures to ensure iodine content in salt.

Treating Tuberculosis

Tuberculosis (TB) is caused by *Mycobacterium tuberculosis*, a slow growing bacterium, which evolved from soil bacterium more than 10,000 years ago. The history of this disease is very old, but its prevalence was rare. The number of cases of TB increased rapidly after the 19th century mainly as a consequence of growing population density and industrialization.



IN CONVERSATION

E-mail interview with Dr. V.M. Katoch, Secretary, Department of Health Research & Director General, Indian Council of Medical Research, New Delhi

The canvas of medical research in India seems to be extensive and broad due to diverse climatic conditions and socio-economic factors. In such a scenario, what are the research priorities of ICMR?

Our main goal and objective is reduction in the total burden of disease in the country and to promote health and well being of the population by bringing in modern technologies for the people. As per our policy, the Council's research priorities coincide with the National health priorities which include control and management of communicable diseases, fertility control, maternal and child health, non-communicable diseases, control of nutritional disorders and developing alternative strategies for health care delivery systems.

Beyond this, we have specific research programmes on environmental and occupational health, mental health and drug research, research on traditional remedies, oral health, health systems research and social behavioral aspects and several other relevant areas.

Currently we are witnessing an era of cutting-edge technologies that are poised to revolutionize scientific research scenario in various sectors. What is the situation in medical research in ICMR?

ICMR is also embracing frontier and cutting-edge technologies such as nanomedicine, molecular medicine and stem cell therapy. The Council is promoting research in these frontier areas though intramural as well as extramural research. In fact, the Council has several schemes to encourage innovations related to diagnostics, treatment methods and prevention vaccines. Translation of the innovations into products and processes by facilitating evaluation and testing in synergy with other departments is one of our major objectives. We are also trying to introduce these innovations into public health service through health systems research.

In the new scenario, ICMR will continue to be the fulcrum of the new Department of Health Research.

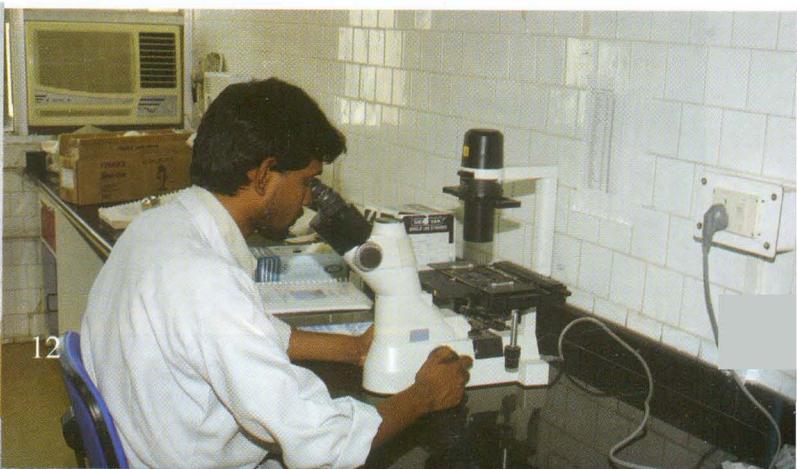
In a classic study by ICMR, famous as the 'Madras Study', it was found that it would be appropriate to treat infected patients in their own homes. This revolutionized the TB treatment methods followed all over the world and resulted in reduction in the need for beds in sanatoria and hospitals for TB patients, reduction of the cost of treatment for both the patient and the provider (for the cost of treating one patient in a sanatorium, 100 patients could be treated

on an out-patient basis) and the treatment was more acceptable socio-culturally. This also paved the way for integrating TB services into primary healthcare.

Rifampicin, an anti-TB drug, was discovered in 1967 and is hailed as one of the greatest achievements in the history of development of anti-TB drugs. With the availability of two well-tolerated and highly effective drugs – rifampicin and pyrazinamide – the clinical trials of short-



SCIENCE REPORTER NOVEMBER 2011



Recently we have seen a spurt of Government policies, bills and guidelines on health related issues. These are being debated in various public forums as well. What is the role of ICMR in formulation of these?

ICMR, through its vast network of 31 research institutes and centres, is a major player in formulation of various policies and guidelines related to public health issues. The Council provides technical inputs duly supported by scientific researches for deliberations, thus facilitating the decision making process. For instance, based on ethical guidelines for experiments on human subjects, a draft bill on Biomedical Research on Human Subjects has been prepared. Similarly, ICMR has made significant contributions in the preparation of the National Health Policy and Knowledge Management Policy of the Department of Health Research. The guidelines developed by the Council for assisted reproductive technologies are at the core of a draft bill on the subject.

Does ICMR play a role in health management of the affected population during natural calamities or man-made disasters?

Yes, ICMR and its institutes always rise to the occasion and lend a supporting hand to the authorities by providing required medicare facilities and expertise in natural and manmade disasters. The Council has shouldered research investigations into the Bhopal Gas disasters, Orissa cyclone, and

Marathwada and Bhuj earthquake disasters. The ICMR focused on mental health consequences with special reference to mental health service needs and service delivery models for the earthquake affected populations in Marathwada and Gujarat. During the devastating tsunami in 2004, ICMR assisted the state authorities in establishing emergency disease surveillance systems in the affected states of Tamil Nadu, Andaman and Nicobar Islands, Pondicherry, Kerala and Andhra Pradesh. Assessment of post-traumatic stress disorder among the adults in the tsunami-affected areas was also undertaken. Similarly, we had set up a specialized research set-up at Bhopal within a month of the Bhopal Gas Tragedy to study the far-reaching impact of the toxic gases. Ultimately, ICMR came out with three technical reports that became a source of reference for further research studies.

What are the major challenges before ICMR and how do you plan to tackle these?

The rapidly growing economy has thrown unique challenges in the health sector: a population that is divided into an increasing number of middle and upper middle class and the marginalized segment of society. The health challenges continue to be huge, and complex. We have, at the same time, serious problems of malnutrition, both under-nutrition among children and growing problem of obesity in school going and adolescents, continued

infectious disease burden among the poor to rising cardiovascular disease and diabetes disease load among the rich. What is more, 'development' – rapid industrialization of India, use of pesticides and fertilizers for improving crop yields— are rapidly degrading the environment, causing air and water pollution resulting in several health problems from chemicals in breast milk to increasing cancers in different communities.

Today, the ICMR stands out as a formidable and strong structure having 31 national and regional institutes and more than 100 field stations under its fold. More significantly, the Council has been able to successfully access the strong medical college system across the country and support/collaborate with other national research institutions.

It is, therefore, imperative that ICMR be further strengthened by continuous modernization of its own institutions as well as by opening of new centres focused on the new emerging communicable and non-communicable diseases, cutting-edge basic science like transplant immunology, genomics, proteomics etc., strengthen infrastructure for animal experiments, clinical pharmacology, critical health policy issues, health systems research, socio-behavioral science research etc. In the new scenario, ICMR will continue to be the fulcrum of the new Department of Health Research, dedicated to taking modern health technology to the people.

Non-Communicable Diseases including cancers, affect sizeable numbers of our population.

course chemotherapy (SCC) regimens made it possible to reduce the length of treatment from 12 to 6 months. The introduction of SCC regimens was a milestone in the Council's fight against TB.

ICMR was also instrumental in development and implementation of the internationally recommended TB control strategy i.e. DOTS (Directly Observed Treatment Short Course), which promotes diagnosis by sputum smear microscopy, direct observation of treatment, standardized regimens, recording and reporting of notified cases and treatment outcomes. DOTS services are now available in 563 districts of 26 states/union territories.

Improving Reproductive Health

Reproductive health is a crucial part of general health of a person and is also a central feature of the development of a human being. The research on this important aspect was initiated in the earlier days of IRFA, but the studies mainly focused on problems associated with maternal morbidities. Now, ICMR has made deep inroads in various research areas, such as fertility regulation, infertility and reproductive disorders,

NATIONAL HEALTH PROGRAMMES

- National Malaria Eradication Programme
- National Filaria Control Programme
- National Leprosy Control Programme
- Diarrhoeal Diseases Control Programme
- National AIDS Control Programme
- Iodine Deficiency Disorders (IDD) Programme
- National Cancer Control Programme
- Universal Immunization Programme
- National Tuberculosis Programme

reproductive tract infections, maternal and child health, unsafe abortions, menopause and osteoporosis, adolescent health, reproductive cancers and stem cell biology.

TO CURB SUICIDES....

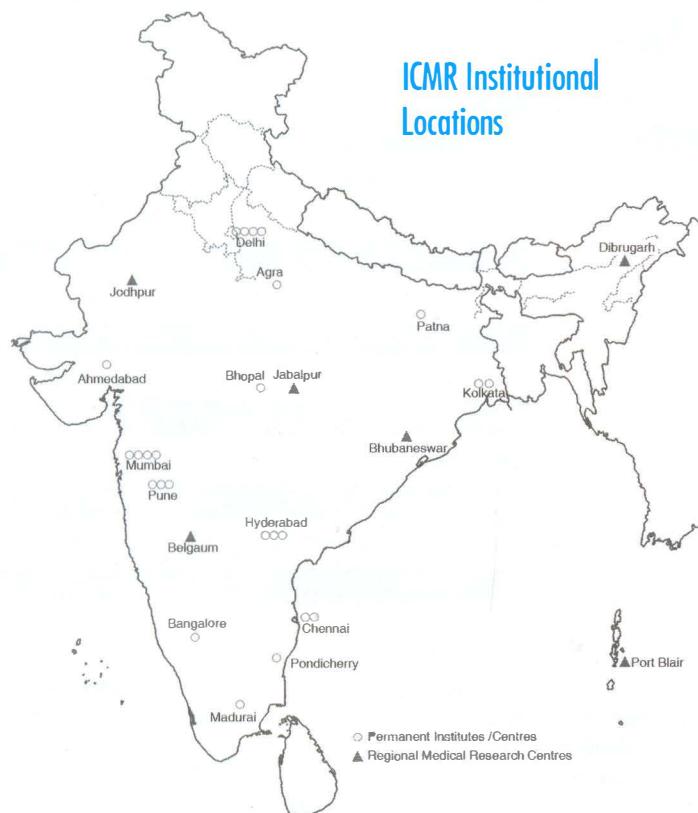
Suicide has emerged as a leading cause of death the world over and in India as well. Considering the increasing number of suicide cases, studies on suicide behaviour were carried out on suicide attempters, who were brought for management to various hospitals. A more comprehensive project with community-based and hospital-based components has been initiated to study the entire range of suicide behavior from suicidal ideation to suicide attempts.

Research studies of the ICMR have helped developed a simple tool for use by general physicians to identify persons with suicidal risk as it was found that a large proportion of persons attempting suicide were in contact with a treatment facility for some time before suicide attempt. A community-based task force project on suicide behaviour has now been undertaken for the first time. It is expected that the ongoing research on suicide behaviour will help in evolving strategies for suicide prevention. A multicentric project on urban mental health has been initiated to develop strategies for early identification of mental health problems and appropriate services for early intervention.

The Council also initiated studies in the area of mental health indicators. Task force projects were undertaken to develop tools of measurement for quality of life at individual level, family level, and community level. A short instrument was developed to measure psychosocial stress. The Health Modernity Education Project developed the concept of health modernity, developed and evaluated health educational intervention to enhance health modernity of tribal population in Jharkhand.

The birth of India's first scientifically documented test-tube baby was possible through the research endeavors of scientists working at ICMR's labs and the KEM Hospital, Mumbai. The scientists of the Council have developed simple, cost-

effective and accurate methods for the diagnosis of fertility status. Some of the successful technologies have been transferred to industry with a view to developing appropriate kits for wider use.



TAMING HEALTH

HAZARDS IN FIELDS

ICMR undertook several studies to examine health and safety of workers in agriculture. Research on the problems of the agricultural work force tries to resolve problems of the work environment, to alleviate rigors at the workplace and to improve performance ability of the workers. Emphasis has been given on the principles of ergonomics, i.e., work simplification and workload classification, modification of work methods and manually operated tools and implements.

Occupational health problems associated with tobacco cultivation are known as "Green Tobacco Sickness" (GTS). It is a mild and acute form of nicotine toxicity that affects tobacco workers who have direct dermal contact with tobacco plants during cultivation and harvesting. Headache, nausea, vomiting, giddiness, and loss of appetite, fatigue, weakness and sometimes fluctuations in blood pressure or heart rate characterize it. GTS was first reported from U.S.A. in 1970.

Later, it was also reported by the National Institute of Occupational Health in Indian tobacco harvesters in 1979 and 1986. In tobacco harvesters, nicotine gets absorbed mainly through the skin of the hands. Gloves would, therefore, be the most logical solution. Two types of gloves were provided to non-Virginia tobacco harvesters who suffered from green tobacco sickness (GTS).

Use of both the types of gloves showed significant reduction in prevalence of GTS and in nicotine absorption as reflected by nicotine and creatinine excretion rate in urine. It was found that with respect to GTS, the use of rubber gloves afforded protection to 93% of the subjects, while with cotton gloves the proportion was 78.5%. Both the types of gloves were found saturated and encrusted with thick plant sap during harvesting and they were difficult to wash and clean after short-term use. Different types of gloves are now being tried for testing their acceptability and efficacy.

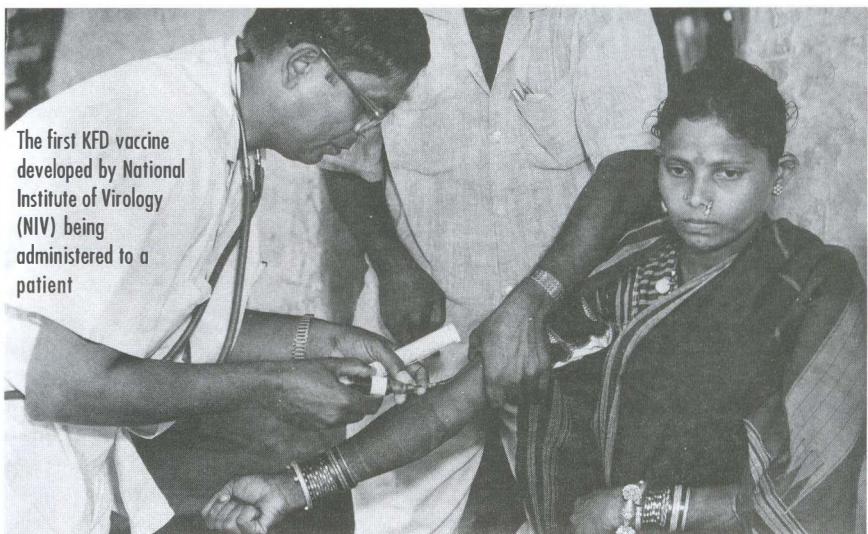
As anemia and toxemia were found to be the primary reasons for morbidity and mortality of this vulnerable group, the Council provided support for conducting research on them. The studies showed that while the administration of 5 grains of ferrous gluconate prevents the development of anemia in approximately 60% cases, the combination of the above with 5 mg folic acid could prevent the development of anemia in almost 80% cases. Thus, the administration of iron along with folic acid was found to be helpful in the prevention of occurrence of anemia during the pregnancy period.

Studies conducted by ICMR were helpful in formulation of various policies and guidelines related to the family planning programme of the Government of India. In 1977, the Government of India recognized the need to review its national programmes on population stabilization and welfare of the families. This assessment resulted in a major paradigm shift. The focus was shifted from "family planning" to "family welfare".

Cancers and Cardio-vascular Health

ICMR is vigorously engaged in the preparation of the Cancer Atlas of India including most regions of the country to facilitate policy planning and prevention strategies. Cancer patterns vary not only throughout the world but also between different population groups within the same country. The preliminary and subsequent reports of the National Cancer Registry Programme (NCRP) have shown that cancer of the stomach is a consistent leading site of cancer among males in Bangalore and Chennai, whereas it is lesser so in Bhopal, Delhi or Mumbai. Similarly, cancer of the gall bladder is a leading site of cancer especially among women in Bhopal and Delhi, but is hardly seen in Bangalore and Chennai.

Cardio-vascular Diseases (CVD) cover a wide array of disorders, including diseases of cardiac muscles and of the vascular system supplying the heart, brain, and other vital organs. These diseases accounted for less than 10% of the global disease burden in the beginning of the 20th century, but by the turn of the century the figure had reached 30% with replacement of rheumatic heart disease by primarily ischemic heart disease, stroke and congestive heart failure. Importantly, about 80% of the CVD disease burden occurs in low and middle-income countries.



The first KFD vaccine developed by National Institute of Virology (NIV) being administered to a patient

Among the other CVDs, ischemic heart disease (IHD), manifested mainly as angina and acute myocardial infarction, is the leading killer in age group ≥ 60 years globally. The currently available interventions for CVDs are expensive and their demand as effective healthcare tools is increasing in India exerting major pressures on the healthcare system. ICMR, through its network and expertise, is vigorously pursuing various key aspects of CVDs to minimize the incidence of CVDs and devise cost-effective treatment for the large population of the country. Prevention strategies are also being formulated.

Combating HIV/AIDS

HIV Infection was first reported among female sex workers in Chennai in 1986. In the same year, the first case of AIDS was reported in Mumbai. With great foresight, the Indian Council of Medical Research had initiated surveillance for HIV in 1985 and established a network of surveillance centres across the country. The data generated from these centres revealed that India had an imminent HIV epidemic at hand. The data generated by this first network of surveillance centres provided evidence for initiation of the National AIDS Control Programme that was implemented by the newly established National AIDS Control Organization. This was also followed by the establishment of research institute by ICMR fully devoted to research on HIV/AIDS—the National AIDS Research Institute in Pune.

The ICMR, through its network of institutions across the country, has made impact on the HIV epidemic through generation of important data that has helped in shaping policies. ICMR is also

working towards the prevention of HIV infection through research on vaccines, microbicides and other biological and behavioural strategies. Providing care and support through research on newer drugs and treatment regimes, increasing adherence to ART and prevention of HIV drug resistance emergence and providing psychosocial support to those already infected is central to the agenda on care and support.

Research on immunology, molecular biology and virology of HIV infection will continue to help put in place pieces of the jigsaw puzzle of the biology of HIV infection in context with HIV-1 subtype C. And, most importantly, the operational research that complements the National AIDS Control Programme will remain the cornerstone of HIV research under ICMR.

Despite substantial progress made on many fronts, there are still areas of concern. Maternal and Infant Mortality are still unacceptably high in several areas, infectious diseases continue to remain a threat to public health. Non-Communicable Diseases including cancers, cardio-vascular diseases, diabetes and mental illnesses affect sizeable numbers of our population. ICMR is making all-out efforts to provide due support through strategic and demand-driven medical research across the board.

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The Rhinoceros beetle, *Oryctes rhinoceros*, has emerged as a serious pest of coconut and Oil palm. Credited as the strongest creature on earth in proportion to its body weight, control of this beetle is not an easy affair. But through integrated pest management a coastal panchayat in Kerala has succeeded in the war against this pest without the use of chemical pesticides. Edava is a coastal panchayat in Varkala Block area of Thiruvananthapuram District in Kerala. The majority of farmers have coconut plantations and income from coconut palms has been the major livelihood since hundreds of years.

Being a coastal area, phytosanitation was a problem here. This gave ample chance for the rhinoceros beetle to breed and multiply in large

Modern biotech medicines are well established in the treatment of many ailments, including some life-threatening ones, with the likelihood of increasing use in future years. Having said that, patients need to discuss access, cost, safety and efficacy of receiving biosimilar medicines as these are now an emerging source of affordable medicines for more patients.

Also known as follow-on biologics, biosimilars are approved new versions of innovator biologic drugs that are developed after the innovator's patent expires. Unlike generics, however, biosimilars are not exact replicas of biologic drugs. To comprehend the implications, we need to take a closer look at how

numbers. Rhinoceros beetle in its adult stage bores into un-opened fronds and spathes of coconut. The attacked frond when fully opened shows characteristic triangular cuts. Infestation on spathe often destroys the inflorescence, and thus prevents production of nuts.

The beetle breeds on decaying organic debris, farmyard manure, dead coconut stumps, logs and compost. Rhinoceros beetle has a lifespan of about 90 days and it attacks all stages of the palm right from seedling stage to adult palm, causing heavy loss to farmers. Attack in young seedlings results in stunted growth and delayed flowering. Body of the beetle is covered by thick exoskeleton making control further difficult.

WAR AGAINST A STURDY BEETLE

"Farmers used to apply a mixture of sand, salt and charcoal on tree axils to control Rhinoceros beetle," says Thejasvi Bhai, Agricultural Officer, Edava. "Another method was hooking and killing the beetles using metal hooks. Both these measures were not effective in bringing down the beetle population. Due to shortage of skilled labourers for even harvesting coconuts, this kind of control was out of the question. Other prophylactic measures like application of oil cakes of neem or marotti (*Hydrocarpus wightiana*) in powder form mixed with equal volume of sand in to the top most three leaf axils around the base of the spindle leaf during May, September and application of naphthalene balls in the leaf axils at the base of the spindle @ 12 g/palm

covered with sand also became impractical. So we thought of an integrated, less labour intensive option."

With the technical support of CPCRI (Central Plantation Crops Research Institute), Kayamkulam, Edava organized farmers in the war against the beetle. A three dimensional strategy was used for controlling the beetle. Oruveran (*Clerodendron infortunatum*) is a weed that grows in coconut gardens. This has larvicidal properties. Krishi Bhavan officials advised the farmers to apply this plant in Rhinoceros beetle breeding sites. This measure helped to control grubs up to a little extent only. As a second measure, pheromone traps were erected in coconut gardens, but adoption was poor.

BIOSIMILAR MEDICINES: ARE

chemical molecule drugs and biologics are made.

For small molecule generics manufacturers "the product is the product", while manufacturers of innovator biologics claim "the process is the product". These inscrutable statements become clear once we understand the manufacturing process of both drugs. Biosimilars are large molecules produced by living organisms with high molecular complexity and susceptible to the smallest manufacturing process changes, while small molecule generics are produced by chemical synthesis with high levels of stability. Therefore, even a minor change in the process or materials used in

manufacture means the biosimilar drug may have serious differences in treatment outcomes and side effects.

To elaborate, biologic drugs are manufactured by genetically engineered living cells making them miniature factories that produce the desired molecules (proteins). Even minor changes in their environment can, however, significantly alter the proteins these cells are engineered to produce. Any biosimilar manufacturer using similar starting materials and processes may still produce a product that differs from the innovative biologic drug. Moreover, given the complexities of biologics it

WE READY?

is impossible to determine in a laboratory whether a biological product will work in the same way as its original innovator.

In other words, with the original biologic purification process not available to biosimilar makers, biosimilars can never be made in exactly the same manner as the original biologic drug. Among various potential risks of biosimilars, differences in immunogenicity represent one such concern. While generics generally lack immunogenicity, biosimilars are immunogenic – that is, they are inclined to activate an immune response in the



Rhinoceros beetle grub



Rhinoceros beetle



Then, scientists at CPCRI found that successful control of Rhinoceros beetle in larger areas could be achieved using a viral pathogen *Baculovirus Oryctes* (OBV) and a fungal pathogen *Metarhizium anisopliae*.

"The second option was the green muscardine fungus pathogen *Metarhizium anisopliae*, multiplication of which seemed easier," says Dr. Anitha Kumari of the Extension Division of CPCRI. "For this we formed a group of 20 women. They were trained in multiplication of green

muscardine fungus using half cooked rice as medium. Mother culture was supplied by CPCRI. About 2000 packets of fungi culture produced by them were supplied to farmers of the panchayat. The group also gave advice to the farmers regarding the method of application of the fungi culture in breeding sites. The adoption was very high and population of Rhinoceros beetle was drastically reduced. Green muscardine fungi attack and kill grub, pupa and adult stages of the fungus and once applied the fungus will be there for up to a year.

patient's body. This immune response may cause antibodies in the patient's body to attack and neutralise the biosimilar. Sometimes, this could have serious consequences and may even threaten the patient's life. Since the immunogenicity of biologic drugs is unpredictable, even small changes in a molecule could completely alter the immunogenicity profile.

Therefore, effects of the differences between a biosimilar drug and its innovator product can only be established by putting the biologic product through substantial clinical testing in patients to determine its safety and efficacy. Considering these constraints, it is virtually difficult to create an identical generic of a branded biologic. Due to this drawback, regulatory authorities in many countries are wary about approvals to biosimilars and recommend extensive clinical trials to be undertaken before it can be given to patients.

Given these variations, the European Medicines Agency (EMEA) makes a distinction in approvals between biosimilars and

So, one needs to apply the culture once in a year only."

A packet of fungi culture is supplied by the group of women for a mere 15 rupees. Still they get Rs.7.50 as profit by selling one packet.

"It is a good self employment venture for us. Now more and more people are approaching us for fungi culture," explained Ambika,

the leader of group of women. "Further, we trained a women group at Kasaragod District via video conferencing on the methodology of multiplying the fungus and its application. Inspired by our success Cherunniyur, another panchayat in Thiruvananthapuram District also initiated a similar project."

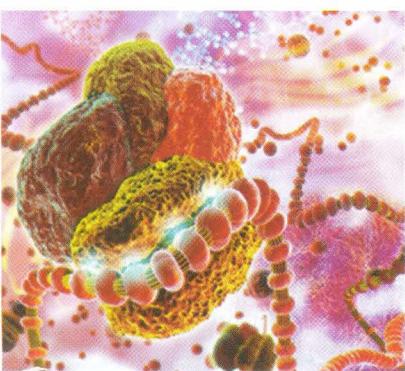
Contributed by Mr G.S. Unnikrishnan, Assistant Director of Agriculture, Farm Information Bureau, Thiruvananthapuram-695003; Email: vanchiyurunni@gmail.com; unni_krishnan1@hotmail.com

generics, recognising that the generics approach is unsuitable for biosimilars. EMEA guidelines therefore require extensive testing before approval for biosimilars and also treat each biosimilar approval on a case-by-case basis. Similar concerns about safety and efficacy have led the US FDA to rule that each biologic is unique and wholly interlinked with the manufacturing process used to make the drug.

Finally, one needs to remember that biosimilars are promoted primarily on the basis of cost advantage, being cheaper than innovative biologic drugs. Considering the various safety and efficacy risk factors, though, their cost advantage is largely negated. Unlike the US,

Europe, Canada and Japan, which have specific regulatory approval processes for biosimilars, the risks in India are higher, because so far, there are no established regulatory approvals in place and biosimilars can be approved with limited clinical trials. This allows manufacturers to adopt abbreviated pathways and avoid stringent norms, thereby compromising patient safety. But lower drug costs are not worthwhile if it means risking patients' lives and their well being.

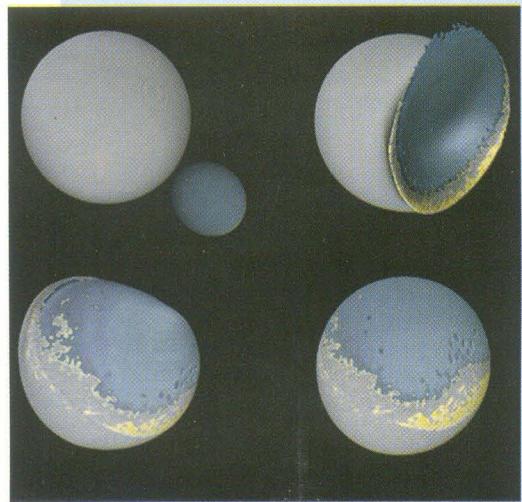
Contributed by Dr Rajendra Prasad, Professor, Molecular Medicine, School of Life Sciences, Jawaharlal Nehru University, New Mehrauli Road, New Delhi-110067



THE MISSING MOON

Symmetry is the law of nature. Then why is the shape of the moon unsymmetrical?

Since long, astronomers have been examining various probabilities to find an answer. One such, supposed to be the most popular, suggests that during the early stage of its formation, gravitational tidal forces reshaped the moon's crust and made it lopsided. However, recently a team of researchers from the University of California at Santa Cruz have come up with a new idea, which appears to be the most probable one.



According to it, as reported in a recent issue of the journal *Nature* (4.8.2011), once upon a time, the earth had a second satellite, which was smaller in size and slower in motion than the one adorning the sky today. Both these moons circled around

the earth together for a pretty long time. Through a "giant impact" the smaller one amalgamated with the bigger one on its far side, which became high and mountainous with a much thicker crust as compared to the relatively low and flat near side. Thus, its symmetry was lost.

Many astronomers believe that during the early history of the solar system, when the earth was not as solid as it is today, a planet size celestial object collided with it, ejecting debris, that was later pulled together by gravity and hardened to form the moon. According to them, the giant crater thus created formed the Pacific Ocean. In support of the theory, they cite the fact that the volumes of both these are roughly equal.

Now, the Santa Cruz team led by Professor Erik Asphaug claims that during that event, in fact, another small moon was also formed. It remained in the orbit for tens of million years along with its bigger sister. Thereafter, the two moved closer to each other and collided slowly. Perhaps the collisions took place in four stages nearly 4 billion years ago. As a result, the smaller moon was missed from the sky forever.

Since the impacts were slow, these neither produced craters nor caused much melting. Instead, the colliding materials only piled up at the site of collision, the far side of the moon.

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NEWS BRIEFS

■ Scientists are reporting deep new insights into the whys and hows of the famous caste system that dominates honey bee societies. Although queen and worker bees share almost identical genes, their destinies could be more different. The differences include changes in the amounts of protein produced in cells and the activity of those proteins. In pre-queen larvae, proteins involved in carbohydrate and energy metabolism, for instance, are much more active than in workers.

■ Biologists have identified more than 70 genes that play a role in regenerating nerves after injury, providing biomedical researchers with a valuable set of genetic leads for use in developing therapies to repair spinal cord injuries and other common kinds of nerve damage such as stroke. They were also surprised to learn that some of the genes involved in the re-growth of axons were known to have other functions, such as regulating the release of neurotransmitters.

■ Beta-blocker drugs, commonly used to treat high blood pressure, may also play a major role in slowing the progression of certain serious cancers, based on a new study. The earlier studies first used tissue from a nasopharyngeal carcinoma cell line, and later from both multiple myeloma and melanoma cell lines. When treated with the beta-blocker propanol, all cells stopped producing the tumour-enhancing molecules. Similar work by other scientists showed similar results with ovarian cancer tissues.

■ Yawning is not just a sign of tiredness or boredom – it is the body's method of keeping our brain cool, scientists have found. Like a computer, the brain works best when it is cool, but putting too great a strain on it can lead to overheating which reduces its ability to process information. When the head begins to heat up, yawning acts as a natural "thermostat" by allowing cool air to rush in and bring the brain back down to a healthy temperature, research suggests.

■ Eating fresh fruits and vegetables helps people resist the temptation of waist-expanding treats, scientists have found. When our supplies of glucose – found in carbohydrates – drop we begin to lose our ability to control desire, while our urge to eat increases. The lack of glucose – which is used to power the brain – makes us helpless against the urge to reach for high-calorie foods. When glucose levels were lower, the prefrontal cortex – which gives us self-control – lost its ability to control the impulses.

■ A new study puts an end to the long standing debate about how archaic birds went extinct, suggesting they were virtually wiped out by the same meteorite impact that put an end to dinosaurs 65 million years ago. The uncertainty was due to the fact that very few fossil birds from the end of this era have been discovered. Now palaeontologists have provided clear evidence that many primitive bird species survived right up until the time of the meteorite impact.



Chromosomes, Cancer and Cure

Can the dreaded cancer be controlled? A recent discovery could provide an approach to successfully tackle cancer.

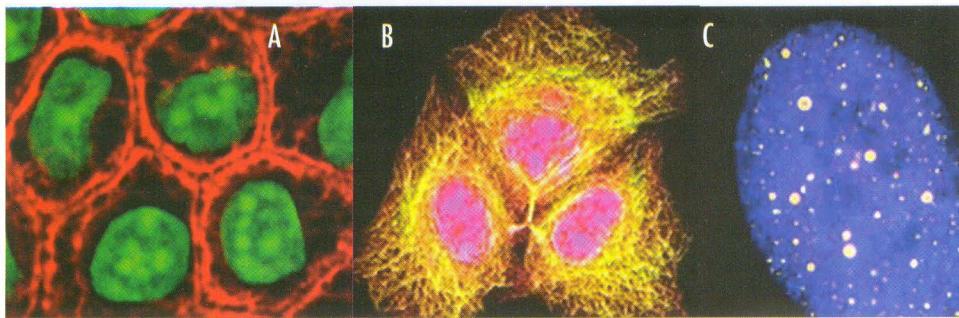


Figure 1. Normal and cancer cells of human beings
(a) Normal cells, (b) HeLa cells and (c) ALT tumour cells with pink telomeric end

Ofall the afflictions of human kind, cancer inspires a particular dread. Perhaps it carries a tradition of hopelessness and seems to pose a mystery that defies our otherwise remarkable medical and scientific skills. So, what is cancer, why is it so dreaded and is there a cure?

Cancer is a complicated set of diseases characterized by uncontrolled growth and spread of abnormal cells. If the spread is not controlled, it can result in death. The difference between cancer cells and normal human cells is profound, not only because they look and behave differently, but because of the radical difference in their life spans. In stark contrast to normal cells, which only divide a finite number of times (approximately 50 generations) before they enter into a permanent state of growth arrest or simply die, cancer cells never cease to proliferate.

The only known immortal cells in the body are germ cells (sperm and egg), although they too eventually die out if an individual never has children. Similarly, stem

cells also proliferate for years in culture. This has been used beneficially in medical therapies to extend the human life span. But, apart from germ cells and stem cells, the acquisition of immortality by a somatic cell always leads to trouble.

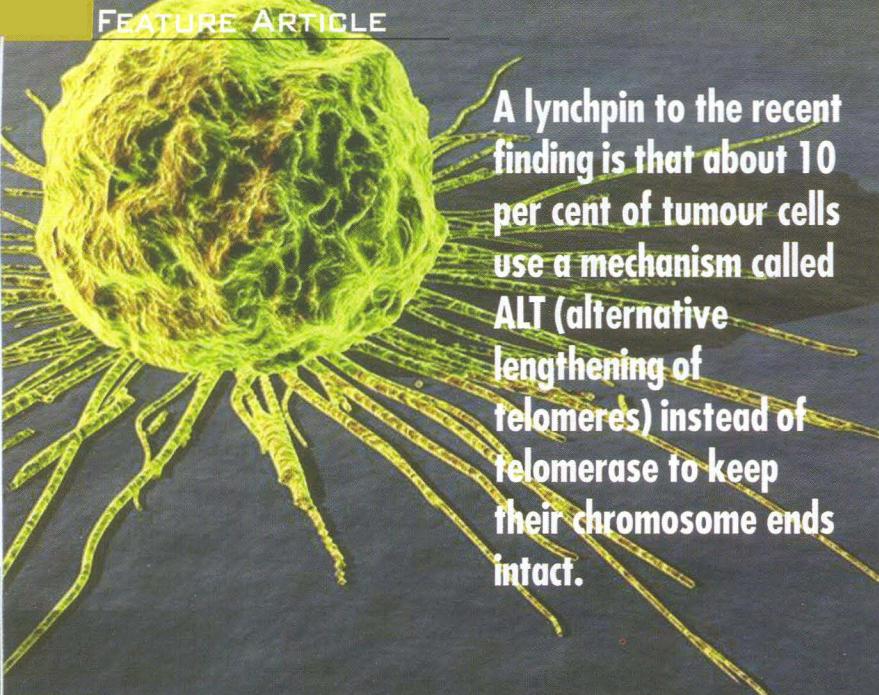
Cancer cells are produced by somatic cells that have gone mad. Normal cells, on the other hand, are the sanest community of cells that work together for good, are well organized, hard working and content with their activity. For example, heart cells enjoy pumping blood, brain cells would not change place with skin cells and no way would any normal cell do anything that would jeopardize the health of the body they so carefully constructed.

Cancer cells don't care about this. They do what they want and go where they please. If they decide to build a large tumour in the middle of the brain that is what they are going to do, even if it kills the body they are living in. That is why we fear and loathe cancer. The best proof of cancer cell immortality came from the HeLa cell that was established in 1951 from a cervical tumour isolated from a woman named Henrietta Lacks. Cells contributed

by her have been growing ever since (Fig. 1b) and cultures of these cells are maintained for research by laboratories around the world. She was a native of USA and was 31 years old when the tumour was discovered. She died of cervical cancer eight months later.

Normal cells become cancerous when they mutate into abnormal cells through a process called transformation leading to uncontrolled growth eventually forming a tumour or neoplasm. As long as the tumour remains intact, and its cells don't invade other parts of the body, the tumour is called benign, and can easily be treated by surgical removal. Tumours become dangerous and potentially deadly, when some of the cells develop the ability to leave the main tumour mass and migrate to other parts of the body and form new tumours; such tumours are malignant.

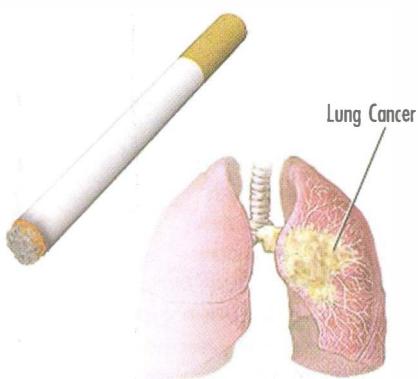
The spread of cancer by this process is known as metastasis. Malignant cancer can be very difficult, if not impossible, to treat. The danger associated with all tumours is that they will switch from benign to malignant before being detected.



A lynchpin to the recent finding is that about 10 per cent of tumour cells use a mechanism called ALT (alternative lengthening of telomeres) instead of telomerase to keep their chromosome ends intact.

Cancers are classified according to the tissue and cell type from which they arise. Cancer that develops from (i) epithelial cells are called carcinomas; (ii) those arising from connective tissue or muscle are called sarcomas; (iii) and those arising from blood-forming tissue, such as the bone marrow, are known as leukemia.

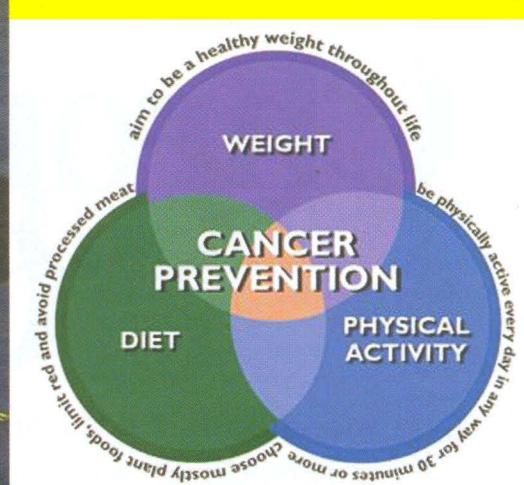
A big question: "Can cancer be prevented"? All cancers caused by cigarette smoking and heavy use of alcohol can be prevented completely.



However, for medical purposes cancer is classified on the basis of a precise cancer staging. It assesses tumours in three ways: extent of the primary tumour (T), absence or presence of regional lymph node involvement (N), and absence or presence of distant metastases (M). Once the T,N,M are determined, a stage of I, II, III or IV is assigned with stage I being early and stage IV being advanced diseases.

For descriptive and statistical analysis of tumours a different system of staging such as *in situ*, local, regional and distant is used. If cancer cells are present only in the layer of cells where they developed and have not spread, the stage is described as *in situ*. If they have penetrated the original layer of tissues, the cancer is described as invasive. This helps in better understanding of molecular properties of cancer and is essential in determining choice of therapy and developing a prognostic model for cure.

The risk of developing cancer is equal for all human beings. However, the risk increases as individuals age. In most cases, it occurs in adults who are middle-aged or older. A person with *Life time risk* of cancer refers to the probability that an individual, over the course of a lifetime, will develop or die from cancer. Relative risk compares the risk of developing cancer in persons with a certain exposure or trait to the risk in persons who do not have this characteristic. For example, tobacco smokers are about 25 times more likely to develop lung cancer than nonsmokers, so their relative risk is 25.



Scientific evidence suggests that about one-third of the cancer deaths expected to occur due to overweight or obesity, physical inactivity, and poor nutrition can also be prevented.

Additionally, about 5% of all cancers are strongly hereditary, in that an inherited genetic alteration confers a very high risk of developing cancer. However, most cancers do not result from inherited genes but from damage to genes occurring during one's lifetime. Genetic damage may result from internal factors, such as hormones or the metabolism of nutrients within cells, or external factors, such as tobacco, chemicals and sunlight. About 1,529,560 new cancer cases were reported in 2010 of which estimated death was 37%. Maximum mortality was from liver (78%) followed by lung & bronchus (71%) cancer, while skin cancer resulted in minimal (2%) death (Table 1).

About 200 types and varieties of cancers have been described in humans and more than 90% are carcinomas, whose properties and treatments are different. For 40 years scientists struggled to understand the mechanism by which cancer cells are immortalized. Throughout the 90s attention was drawn to chromosomes and the tip of the chromosomes (telomeres) that are present in all human cells.

In normal cells, telomeres become shorter each time a cell divides, like slow-burning fuses, acting as a cellular clock ticking down a cell's age. Eventually they are depleted, and the cell enters a permanently arrested state called senescence/death. Contrastingly, in cancer cells an unusual structure is present in the DNA sequence of the telomere. After every division of the cell, this structure

TABLE 1. ESTIMATED NEW CASES OF CANCER AND DEATHS FOR 2010

Cancer	New cases	Death	Mortality (%)
1. Leukemia	43,050	21,840	51
2. Lymphoma	74,030	21,530	29
3. Myeloma	20,180	10,650	53
4. Brain	22,020	13,140	60
5. Skin	74,010	11,790	2
6. Oral cavity & pharynx	36,540	7,880	22
7. Lung & bronchus	222,520	157,300	71
8. Breast	209,060	40,230	2
9. Digestive system	250,210	120,770	48
10. Liver	24,120	18,910	78
11. Kidney & Urinary bladder	131,260	28,550	22
12. Prostrate	217,730	32,050	15
13. Eye orbit	2,480	230	1
14. All sites including unspecified primary sites	1,529,560	569,490	37

Data is from information available on the web site of the American cancer society.
Mortality % is number of death divided by new cases multiplied by 100.

continuously maintains the length/restores the normal size of chromosome by an enzyme called telomerase. Normal cells lack telomerase and for this reason they can't proliferate indefinitely and die.

A recent discovery has uncovered an additional clue to one of the mechanisms underlying cell immortality of cancer cells providing one of the multi-pronged approaches to successfully tackle cancer. Traditionally 90 per cent of human tumours rely on a huge boost in the levels of the telomerase enzyme, which adds DNA to telomeres, thus turning the clock backwards to immortality.

However, a lynchpin to the recent finding is that about 10 per cent of tumour cells use a mechanism called ALT (alternative lengthening of telomeres) instead of telomerase to keep their chromosome ends intact. ALT replenishes shortened chromosome ends through a process called homologous recombination, whereby the intact neighboring DNA of an identical sequence is used as a template to restore the lost telomeric DNA piece. Trying to learn more about the biological tools that ALT tumours use to sustain their immortal status, the team uncovered a new structural beacon, called the "C-tail". It is a string of DNA rich in the base cytosine (C) that hangs over the tip of the telomeres.

The finding came as a big surprise since conventional wisdom had it that cells normally terminate both ends of every chromosome with a single-stranded stretch of DNA rich in the base guanine (G). It was discovered that about half of all telomeres in ALT tumours bore a C-tail, while the presence of such a tail in normal human cells was several hundred fold less prevalent. This suggests that C-tails are a unique feature of ALT tumours.

Although it is a rare phenomenon, understanding ALT mechanism will help develop new drugs for anti-cancer therapies aimed at inhibiting the activity of telomerase through the activation of ALT. Curiously, the evolutionarily distant relative, the roundworm, was shown to have both G-tails and C-tails that team up with two distinct proteins. When the C-tail specific protein was removed from cells, the worm began to exhibit some of the characteristics normally attributed to human ALT tumours. This finding reveals an unanticipated structure at the chromosome ends, which could be a key ingredient in potentially making it an attractive chemotherapeutic target to cut short the life of cancer cells.

At last a big question: "Can cancer be prevented"? All cancers caused by cigarette smoking and heavy use of alcohol can be prevented completely.

Normal cells, on the other hand, are the sanest community of cells that work together for good, are well organized, hard working and content with their activity. For example, heart cells enjoy pumping blood, brain cells would not change place with skin cells and no way would any normal cell do anything that would jeopardize the health of the body they so carefully constructed.

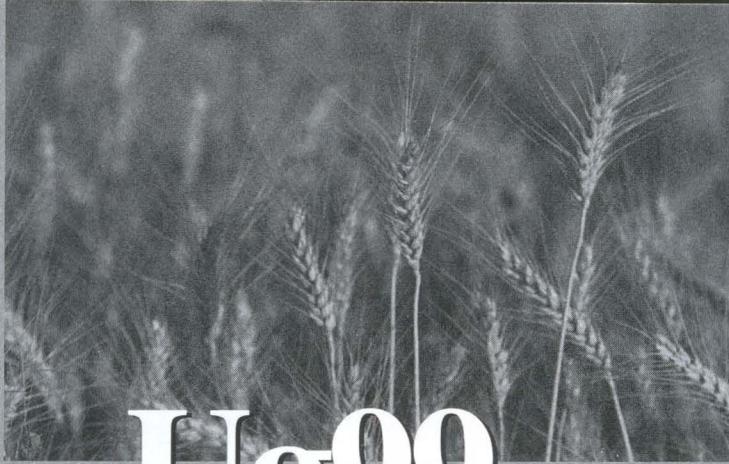
Cancer cells don't care about this. They do what they want and go where they please. If

they decide to build a large tumour in the middle of the brain that is what they are going to do, even if it kills the body they are living in.

Scientific evidence suggests that about one-third of the cancer deaths expected to occur due to overweight or obesity, physical inactivity, and poor nutrition can also be prevented. Cancers related to infectious agents, such as hepatitis B virus (HBV), human papillomavirus (HPV), human immunodeficiency virus (HIV) and others could be prevented through behavioral changes, vaccines, or antibiotics.

In addition, many of the skin cancers could be prevented by protection from the sun's rays and avoiding indoor tanning. Regular screening examinations by a health care professional can result in the detection and removal of precancerous growths, as well as the diagnosis of cancers at an early stage, when they are most treatable.

Dr Prasanta K Dash is Scientist and fellow HHMI, NRCPB on Plant Biotechnology, Pusa Campus, Indian Agricultural Research Institute (IARI), New Delhi-110002 and Dr Rhitu Rai is Scientist; NRC; Email: prasanta01@yahoo.com



Ug99— Threat to Agriculture

PALLABI ROY, SNIGDHA MAJUMDER AND SIRAJ DATTA

Ug99 is a virulent strain of old crop disease "Black Stem Rust" that has evolved to overcome the resistance prevalent in wheat varieties during the Green Revolution of the 1960s. Black Stem Rust is a disease caused by a fungi *Puccinia graminis* in wheat. *Puccinia* is a fungus that belongs to the class Basidiomycetes. This rust fungus of wheat resembling rusted iron rods in wheat stem, plugs the vascular system such that nutrients can not travel from the leaves to the grain resulting in plants producing fewer tillers and seeds, and in cases of severe infection the plants may even die.

Like most rust fungi it requires two hosts to complete its life cycle—Wheat (*Triticum aestivum L.*) and Barberry (*Berberis vulgaris*). The urediniospores (fungal spore) spread over long distances through wind currents rapidly and can affect fields of distant countries within a short time period. Huge crop loss due to this infection can lead to severe famines in countries where wheat is the major staple crop.

Nobel prize-winner Norman E. Borlaug, who helped India and many other countries to avoid the food crisis in the

1960s by developing high yielding crop strains said: "Ug99 has immense potential for social and human destruction. It is capable of severely damaging virtually all of the world's commercial bread wheat. It is a problem that goes far beyond wheat production in developing countries."

Threat to World Wheat Crops

Ug99 was first observed in Uganda in 1999. It has overcome many wheat-resistant genes like Sr24, Sr25, Sr26, Sr27 Sr31, and Sr38 that the other races could not. After Uganda, the spores of Ug99 spread to Kenya through wind current, followed by Ethiopia, Yemen, Iran, southern Sudan thereby threatening regions of the near east, eastern Africa, central and southern Asia. It not only spreads rapidly but also generates new variants able to break the resistance of the wheat varieties grown in these regions.

The deleterious effect of Ug99 is more pronounced (upto100%) with respect to the stem rust that too may reduce crop yield. About 80% yield losses were recently recorded in Kenya and Uganda, though fortunately neither of these countries depends totally on wheat as a staple crop. But for countries like India, where wheat is the major staple crop, Ug99 is a big threat that can lead to a serious food crisis.

Predicted Pathway

The FAO has already alerted Afghanistan, India, Pakistan, Turkmenistan, Uzbekistan and Kazakhstan about the dangerous wheat fungus that may cause a huge loss to wheat production by destroying entire fields.

Stem rust outbreak caused by Ug99 depends on the following key factors: area and distribution of susceptible material; degree of susceptibility; optimum temperatures and moisture; amount of initial inoculum, and air movement. An additional sub-factor that might be added to this list is the historical precedence of the movement of spores through known regions.

The Ug99 spores can attack India following either of the two routes:

Route A: East Africa directly to southern Pakistan/western India (has no known precedent and of much lower probability).

Route B: East Africa–Middle East–West Asia–South Asia (has higher probability). Conditions favourable for outbreaks of epidemics currently exist in the migration path of highest probability.

Indian Approach

The Indian Council of Agricultural Research (ICAR) scientists, engaged in wheat



"Ug99 has immense potential for social and human destruction. It is capable of severely damaging virtually all of the world's commercial bread wheat. It is a problem that goes far beyond wheat production in developing countries."



improvement programme, are trying to protect the crop from Ug99 as wheat directly impacts the country's food security. The country has not faced any epidemic since the last four decades because regular countrywide surveys have been carried out to safeguard the wheat crop against destructive pathogens like Ug99.

WHEAT VARIETIES RESISTANT TO UG 99

- 1. GW 273**
- 2. GW 322**
- 3. HI 1500**
- 4. HD 2781**
- 5. MP 4010**
- 6. HUW 510**
- 7. MACS 2846 (durum)**
- 8. HI 8498 (durum)**
- 9. UP 2338**
- 10. DL 153-2**
- 11. HW 1085**
- 12. Raj 4120**
- 13. PBW 343**

The ICAR, in collaboration with the International Wheat and Maize Research Centre (CIMMYT), Mexico started a testing programme of wheat at Njoro in Kenya since 2005. The tests have shown that there are 13 Indian wheat varieties with resistance to Ug99 and its variants. This diverse resistance in wheat varieties will help them fight against the deadly pathogen and other future threats of this magnitude. The resistant wheat varieties are being multiplied.

It takes a few seasons for the race to build up and appear on a large scale to cause economic losses. Thus, by the time Ug99 reaches India, the already identified resistant varieties should be multiplied rapidly, bred and then aggressively distributed to cultivators to avoid any loss in the farmer's field. As an immediate relief measure, chemical control technology is also available to ensure that this race does not spread and cause damage.

Some fungicides have been identified that can be effective against stem rust. Stem rust can be effectively controlled by some azole fungicides such as tebuconazole, cyproconazole, fluquinconazole, prothioconazole and triadimenol. Strobilurins such as

trifloxystrobin and fluoxastrobin are effective for controlling cereal rust diseases.

There is a need to study the molecular mechanism of wheat and pathogen interaction of susceptible as well as resistant varieties in order to elucidate the biochemical or signaling pathway of the defense mechanism. Analysis of this study can help in the development of broad-spectrum disease-resistant transgenic plants. This will render a cost effective and environmentally friendly approach to combat the threat of Ug99 unlike the chemical treatment that is costly and might have deleterious effect on plants.

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MANY people find numbers quite boring. But for others playing with numbers is a favourite past-time. And so, for those who find numbers boring, here are a few numbers that may sound interesting.

Smith Number

Smith Number is a composite number the sum of whose digits is equal to the sum of the digits of its prime factors. An example of a Smith number is the number 666.

$$666 = 2 \cdot 3 \cdot 3 \cdot 37$$

$$\text{Now } 6 + 6 + 6 = 18$$

$$\text{and } 2 + 3 + 3 + (3 + 7) = 18.$$

The first few Smith numbers are 4, 22, 27, ...

The number 666 is an interesting number:

$$666 = 1 + 2 + 3 + 4 + 567 + 89$$

$$666 = 123 + 456 + 78 + 9$$

$$666 = 9 + 87 + 6 + 543 + 21$$

$$666 = 1^6 - 2^6 + 3^6$$

$$666 = 1 + 2 + 3 + 4 + 5 + 6 + \dots + 34 + 35 + 36$$

Factorion

A Factorion is an integer that is equal to the sum of factorials of its digits. There are exactly four such numbers:

$$1! = 1$$

$$2! = 2$$

$$145 = 1! + 4! + 5! = 1 + 24 + 120 = 145$$

$$40585 = 4! + 0! + 5! + 8! + 5! = 24 + 1 + 120 +$$

$$40320 + 120 = 40585$$

Narcissistic Numbers

An n-digit number that is the sum of the n^{th} powers of its digits is called a narcissistic number.

Examples:

$$153 = 1^3 + 5^3 + 3^3$$

$$370 = 3^3 + 7^3 + 0^3$$

$$371 = 3^3 + 7^3 + 1^3$$

$$407 = 4^3 + 0^3 + 7^3$$

$$1634 = 1^4 + 6^4 + 3^4 + 4^4$$

$$54748 = 5^5 + 4^5 + 7^5 + 4^5 + 8^5$$

10

WALLACE JACOB

Fun With Numbers

4

2

7

3

9

5

Cullen Numbers

Cullen Numbers are numbers that can be expressed in the form $2^n \times n + 1$.

$$3 = 2^1 \times 1 + 1$$

$$9 = 2^2 \times 2 + 1$$

$$25 = 2^3 \times 3 + 1$$

$$65 = 2^4 \times 4 + 1$$

Kaprekar Numbers

If on squaring a number (say x) we get y, and adding the right n digits of y to the left n or $(n - 1)$ digits of y the resultant is equal to the number x, then it is a Kaprekar Number. Examples:

$$9^2 = 81 = 8 + 1$$

$$55^2 = 3025 = 30 + 25$$

$$297^2 = 88209 = 88 + 209$$

Pythagorean Triplets

If n is any odd integer > 1 , and it represents either the base or the perpendicular of a right-angled triangle, then the other two sides are given by $\frac{1}{2}(n^2 - 1)$ and $\frac{1}{2}(n^2 + 1)$.

Interesting Numbers

I. The number 381654729 is a special number because:

The first **two** digits (from the left) form a number that is divisible by **2**:

The first **three** digits (from the left) form a number that is divisible by **3**:

The first **four** digits (from the left) form a number that is divisible by **4**:

The first **five** digits (from the left) form a number that is divisible by **5**:

The first **six** digits (from the left) form a number that is divisible by **6**:

The first **seven** digits (from the left) form a number that is divisible by **7**:

The first **eight** digits (from the left) form a number that is divisible by **8**:

The first **nine** digits (from the left) form a number that is divisible by **9**:

It contains all the digits from 1 to 9 exactly once.

II. The number 2²⁵²⁰ is a special number, because:

It is the smallest positive number (> 1), which can be expressed as a first power, second power, third power, fourth power, fifth power, sixth power, seventh power, eighth power, and a ninth power.

$$(2^{1260})^2, (2^{840})^3, (2^{630})^4, (2^{504})^5, (2^{420})^6, (2^{360})^7, (2^{315})^8, (2^{280})^9.$$

SHORT FEATURE

III. What will be the sum of all the unique four digit numbers that can be formed with the digits 6,7,8 and 9 occurring in each number exactly once.

The common tendency is to write all four-digit unique numbers that can be formed with the digits 6,7,8, and 9:

6789, 6798, 6879, 6897, 6978, 6987
7689, 7698, 7869, 7896, 7968, 7986
8679, 8697, 8769, 8796, 8967, 8976,
9678, 9687, 9768, 9786, 9867, 9876,

and then find the sum (which works out to 199980). **But** there is a shorter method:

The digit 6 occurs in the **thousand's** place 6 times. Similarly, it occurs in the **hundred's** place 6 times and in the **ten's** place 6 times and also in the **units** place exactly six times. The sum of such numbers will be $6 \times (6000 + 600 + 60 + 6) = 6 \times (6666)$.

Similarly, for 7 the sum will be $6 \times (7000 + 700 + 70 + 7) = 6 \times 7777$.

Similarly, for 8 the sum will be 6×8888 .

And similarly, for 9 the sum will be 6×9999 .

$$\text{i.e. } 6 \times (6666 + 7777 + 8888 + 9999)$$

$$= 6 \times 33330$$

$$= 199980.$$

[As an exercise, you can carry out the test for all unique four digit numbers that can be formed with the digits 1,3,5 and 6].

IV. 73939133 is an interesting number because:

7 is prime

73 is prime

739 is prime

7393 is prime

73939 is prime

739391 is prime

7393913 is prime

73939133 is prime

V. The number 6 is a very special number:

$6 \times 1 = 6$	=	6
$6 \times 2 = 12$	=	$(1 + 2) = 3$
$6 \times 3 = 18$	=	$(1 + 8) = 9$
$6 \times 4 = 24$	=	$(2 + 4) = 6$
$6 \times 5 = 30$	=	$(3 + 0) = 3$
$6 \times 6 = 36$	=	$(3 + 6) = 9$
$6 \times 7 = 42$	=	$(4 + 2) = 6$
$6 \times 8 = 48$	=	$(4 + 8) = 12$ and $(1 + 2) = 3 \dots$

The pattern 3, 9, 6 keeps on repeating. How far? (No one knows)

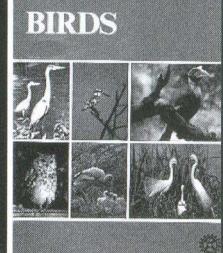
VI. The number 8 is a very special number:

$8 \times 1 = 8$	=	8
$8 \times 2 = 16$	=	$(1 + 6) = 7$
$8 \times 3 = 24$	=	$(2 + 4) = 6$
$8 \times 4 = 32$	=	$(3 + 2) = 5$
$8 \times 5 = 40$	=	$(4 + 0) = 4$
$8 \times 6 = 48$	=	$(4 + 8) = 12$; $(1 + 2) = 3$
$8 \times 7 = 56$	=	$(5 + 6) = 11$; $(1 + 1) = 2$
$8 \times 8 = 64$	=	$(6 + 4) = 10$ and $(1 + 0) = 1$
$8 \times 9 = 72$	=	$(7 + 2) = 9$

We get a decreasing order 8,7,6,5,4,3,2...

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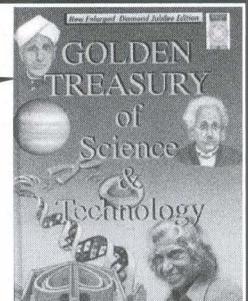
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NISCAIR'S BOOK RELEASE FUNCTION

Exciting Children About Science

"Science communication is the key element in exciting children about science," said Dr Kiran Karnik, former President of NASSCOM, the first Director of the Consortium for Educational Communication (CEC) and someone who spearheaded the launch of Discovery Channel and Animal Planet in South Asia.

He was the Guest of Honour at a function organized to release two new books published by the National Institute of Science Communication And Information Resources (NISCAIR), Council of Scientific & Industrial Research (CSIR), New Delhi. Also present on the occasion were Prof. S.K. Sopory, Vice Chancellor,

Jawaharlal Nehru University (JNU), Prof. Mridula Mukherjee, noted historian and former Director of the Nehru Memorial Museum and Library, and Mr Ge Songxue, Counsellor of Science & Technology Office, Embassy of China in India.

The first book, *Constructing Culture of Science: Communication of Science in India & China*, is an effort to put a wide range of issues related to communication of science and public understanding of science in India and China on the anvil of a serious debate. The second book, *Quality Education & Excellence in Science Research in Indian Universities* gives a bird's eye view of the significant deliberations at the 98th Indian Science Congress held at Chennai in January 2011.

Dr Kiran Karnik cautioned that with very little science being undertaken in universities and with very little science funding, India had fallen far behind South Korea and China. He lamented that the content and facilities for science were missing from the majority of schools in India. And, he said, although we have a few science centers, looking at the vastness and the population of the country the scale is not there. The need of the hour was communicating science more effectively. The challenge for science communication, he said, was creating an excitement in children about science by looking at the method of science.

Talking about the book, *Constructing Culture of Science: Communication of Science in India & China*, Dr Karnik congratulated NISCAIR and China Research Institute for Science Popularisation (CRISP), Beijing for having documented science communication in the two countries in such an excellent fashion.

Earlier, Prof. Mridula Mukherjee, noted historian and former Director of the Nehru Memorial Museum and Library, who released the book *Constructing Culture of Science: Communication of Science in India & China*, said that Pandit Jawaharlal Nehru would have been the most happiest person, not only because the book talks about his favourite topic of science and scientific temper, but also because the book reflected the kind of cooperation and coordination between India and China that he always yearned for. This was the vision he had for the post-colonial world.

Prof. Mukherjee said that Nehru was fascinated by scientific phenomena and science for him was a vehicle for giving people a better life. He believed that we could not have a modern society without a rational society. She was happy that NISCAIR was working towards making that Nehruvian framework a reality.

"CONSTRUCTING CULTURE OF SCIENCE—COMMUNICATION OF SCIENCE IN INDIA & CHINA"

This book is an attempt to narrate the story of science communication in the two most populous and also the fastest emerging economies of the world. For the first time, this volume presents a comprehensive overview of science communication in India and China. There is no book that compares science communication efforts being made in two cultures, in such detail.

The book touches upon the role, efficacy and problems of formal and informal channels of communication in communicating science and also gives an overview of models, methodology, development of indicators and conceptual models that have been used for assessment of the present level of public understanding of science.

The book while giving a glimpse of history of science communication in the two countries, also deals with recent history of development of research in public understanding of science or scientific literacy. There are chapters that focus on the advent and role of science museums, and there are also articles that discuss social movements that have helped in communicating science to large sections of society. The book also deals with the specific problems of science communication to the rural public.

The book is based on 18 chapters—eight by Chinese authors and ten by Indian authors. The book is a collaborative venture between CSIR-NISCAIR and the China Research Institute for Science Popularisation (CRISP).

"QUALITY EDUCATION & EXCELLENCE IN SCIENCE RESEARCH IN INDIAN UNIVERSITIES"

The 98th session of the Indian Science Congress, held at SRM University, Chennai during 3-7 January 2011 chose "Quality Education & Excellence in Science Research in Indian Universities" as the theme for the congress.

Around 8,000 delegates, six Nobel laureates and around 130 leading scientists from India and abroad participated in it. The book records the debates, deliberations and discourses in the 14 Sectional Sessions and the 17 Plenary Sessions addressing key issues such as science policy agenda for the next five years, challenges of maintaining quality education, enhancing academia-industry interaction, addressing challenging science issues of climate change, threat to fragile coastal ecosystems, food and nutrition security and so on.

The book also reports on the Children's Science Congress, the Science Communicators' Meet, and the first National Science Film Festival that were held on the sidelines of the Science Congress.



पुस्तक विमोचन Release of Books

कन्स्ट्रक्टिंग कल्चर ऑफ साइंस - कम्युनिकेशन औफ साइंस इन इंडिया एंड चाइना
Constructing Culture of Science - Communication of Science in India and China
and
क्वालिटी एंड एक्सेलेंस इन साइंस रिसर्च इन इंडियन यूनिवर्सिटीज
Quality Education & Excellence in Science Research in Indian Universities

11 October 2011



Top : Dignitaries on the dais—from left Dr. Gangan Prathap (Director-NISCAIR), Prof. S.K. Sopory (VC-JNU), Dr. Kiran Karnik (Former President NASSCOM), Prof. Mridula Mukherjee (Former Director-NMML) & Mr. Ge Songxue (Counsellor of S & T Office, Embassy of China)

Above left : Prof. S.K. Sopory releasing the book on the 98th Science Congress

Above right : Prof. Mridula Mukherjee releasing the book on science communication in India & China

Mr Ge Songxue, Counsellor of Science & Technology Office, Embassy of China in India, said that the book should be seen as a landmark collaborative effort in the field of science and technology between two of the world's fastest emerging economies that were facing similar challenges. He said it was good to exchange experiences and learn from each other.

Earlier, delivering his welcome address, Dr Gangan Prathap, Director, CSIR-NISCAIR, said that the book *Constructing Culture of Science* had emerged out of the joint efforts of two leading institutes on science communication, one from India and the other from China. "It is welcome," he said, "that for the first time, the wisdom of China and the wisdom of India, at least in the specialized field of science communication, had joined to put together this book."

Prof. S.K. Sopory, VC-JNU, who released the book *Quality Education & Excellence in Science Research in Indian Universities*,

congratulated the NISCAIR team for having done an excellent job of recording what transpired at the 98th Indian Science Congress, preserving it for future generations. He said that quality education has been the key concern of the Planning Commission and excellence was where the country was lacking.

Prof. Sopory said, it was not only necessary to reach science to students but also to those who were not aware of science. However, for that we have to make people ready for receiving science. People, in general, may be interested in gadgets and machines, but the curiosity component was missing. Prof. Sopory said that it was here that institutes like NISCAIR could play a big role by communicating science to the masses. He also commended NISCAIR's scientific journals that were making scientific information available to the people of the country at an affordable cost.

Hasan Jawaid Khan



BUTTERFLY FLIES AWAY

SAMIYA FATIMA

LONG gone are the days when our backyards were hangouts for the beautiful winged jewels. Excited little kids would run around trying to catch them. And when they touched the brightly coloured wings, the butterfly would leave its sparkle behind. How often do we see butterflies around us these days? One of God's most wonderful creatures is in danger and it's about time we humans did something about it.



Gone are the days when our backyards were hangouts for the beautiful winged jewels.

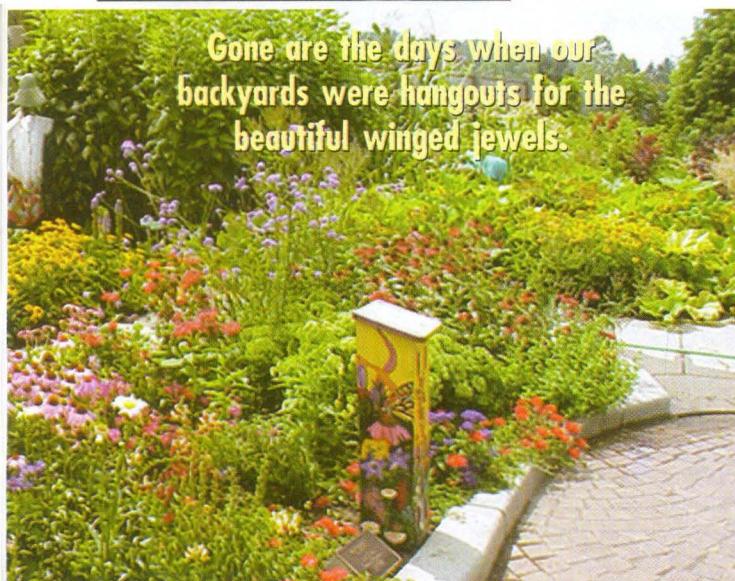
Isn't it frightening to imagine the fate of butterflies similar to that of dinosaurs? The little weightless creature will no longer be filling up our lives. In the next twenty years or so, humans would be seeing butterflies, not just butterflies, but also larvae, caterpillar, and pupae only in books and pictures. Not many little kids would be drawing butterflies in their pre-school because they would not have seen any. Butterflies would only flit around in cartoons and adorn the pretty little dresses of girls.

Kids will not be the only ones missing the butterflies. Plants that depend on insects for pollination will also miss them greatly, especially the beautiful flowering ones. Butterflies play a very important role in pollination. Every living organism has an important role in the web of life; so do the butterflies. Butterflies are selfless creatures and when they fly on to the flowers in search of their food – nectar – they thank the flowers by helping in pollination.

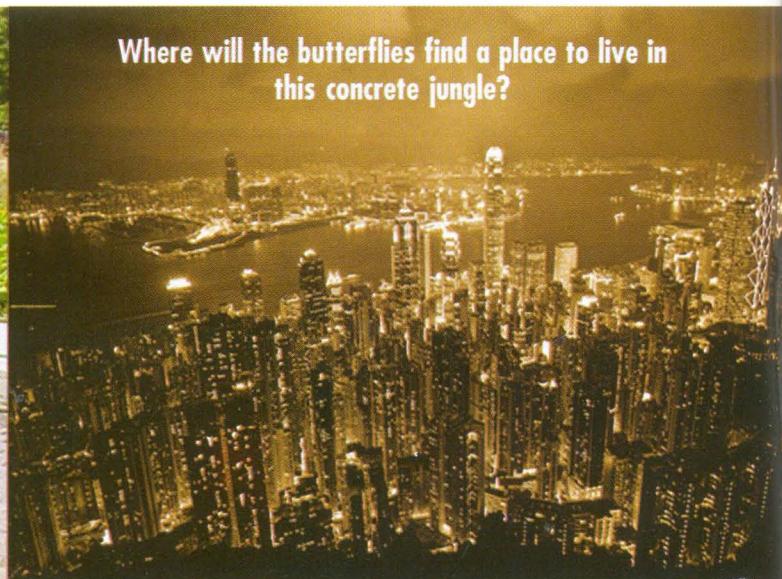
As a matter of fact, ants love to eat caterpillars. However, the caterpillars of the blue butterflies have evolved a symbiotic relationship that is mutually beneficial. Most blue butterfly caterpillars have glands on the 11th and 12th segments which secrete a sugary solution, like honey dew. The ants harvest the honey dew from the caterpillar and in return protect them from other predators. This co-evolution has resulted in butterflies laying eggs, in places where ants are in abundance.

And they have also been doing their bit in reducing global warming. Butterflies are cold-blooded animals. To maintain their body temperatures they absorb heat from their surroundings. Although it is just a drop in the ocean, it does help in reducing global warming to a minute extent.

Having such aesthetic beauty attached with them, it is no wonder they have become a target of smugglers. This has been a major concern in India. Rare



Where will the butterflies find a place to live in this concrete jungle?



Black market butterflies

Butterfly collecting has come a long way since the Victorian caricature of Englishmen in Khaki shorts with enormous nets. Rare butterflies can fetch more than \$ 10,000 on the black market.



Papilio chikae
Lozan Peacock Swallowtail
4.7 Inches each
\$700



Ornithoptera croesus Helios
Birdwing
Female: 6.4 inches
\$ 1,200
Male: 5.2 inches
\$1,800-\$2,000



Ornithoptera alexandrae

Queen Alexandra's Birdwing
Female: 9.5 inches
Male: 7.5 inches
\$ 8,500-\$ 10,000 pair



Papilio hospiton
Corsican Swallowtail
3 inches
\$800-\$1,000

Butterfly smuggling in India has been recorded from way back in 1994, when two German tourists, Heckar Hermann Henrich and Weigert Ludwig, who came to India as tourists, were detained at the Indira Gandhi Airport



and those listed in the endangered list are in great demand. They are killed, dried and used in greeting cards, wall plate hangings and for other decorative purposes. People working in the plantation industry sell these natural jewels to gain extra cash. Apparently some are worth astronomical sums.

Butterfly smuggling in India has been recorded from way back in 1994, when two German tourists called Heckar Hermann Henrich and Weigert Ludwig, who came to India as tourists, were detained at the Indira Gandhi Airport as they were found with four cartons containing nearly 45,000 insects, including butterflies. These were confiscated on the spot and sent to entomologists for identification. Since then many have been arrested, but the smuggling hasn't ended yet.

Another reason for the disappearance of butterflies is the loss of

their ecosystem. Butterflies and caterpillars need plants around them, it's their food, their home. But if you see around your street, all you see is a concrete jungle. How do we expect the brightly coloured winged butterfly and equally bright caterpillars to exist without being spotted in the rather dull grey looking atmosphere?

Butterflies were present in every continent except Antarctica. According to James Speth, an environmental analyst, half the world's tropical and temperate forests are now gone. The rate of deforestation in the tropics continues at about an acre a second. About half the wetlands and a third of the mangroves are gone. Species are disappearing about a thousand times faster than normal. The planet has not seen such a spasm of extinction in 65 million years, since the dinosaurs disappeared. Persistent toxic chemicals can be found by the dozens in essentially each and every one of us.

How could the fragile butterflies have remained untouched by all this? Almost a third of the butterflies in Europe are in danger and one in ten is threatened with extinction, according to a new study.

The Director of the International Union for the Conservation of Nature (IUCN) says, "When talking about threatened species, people tend to think larger, more charismatic creatures such as pandas or tigers, but we mustn't forget that the small species on our planet are just as important

Kids will not be the only ones missing the butterflies. Plants that depend on insects for pollination will also miss them greatly, especially the beautiful flowering ones.

and are also in need of conservation action."

Butterflies are unique in many ways; they are the only creatures with scales on their wings. They taste food by standing on it because of the location of sensors in their tiny feet. They weigh as light as two rose petals.

Can human beings be so selfish and not share the planet Earth with such beautiful and light creatures? We are supposed to be stewards of nature, taking care of it as it provided for us. Nature is infinite in its ability to sustain us.

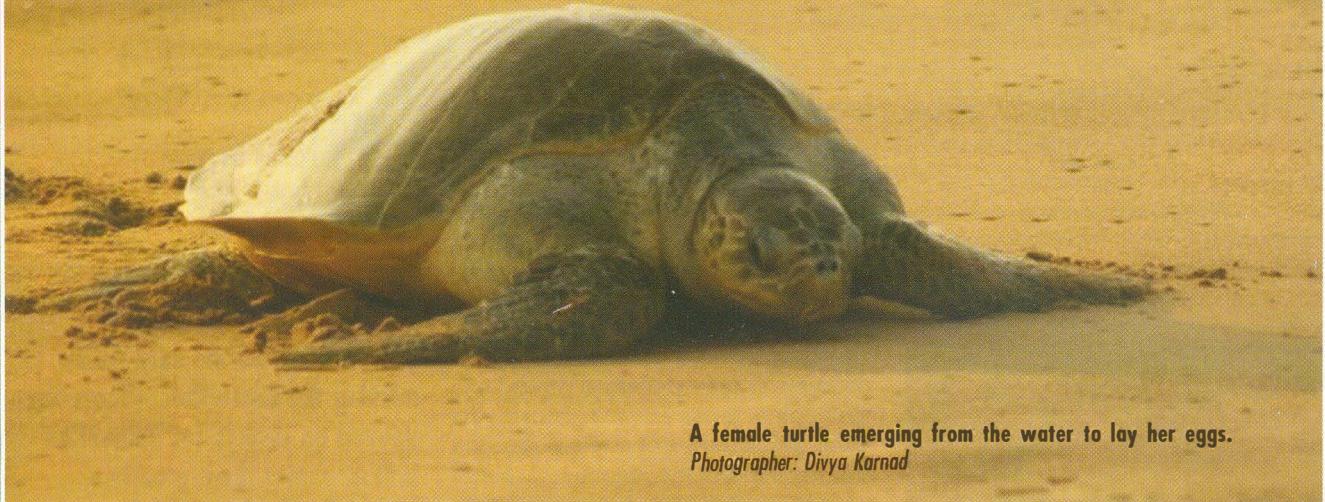
However, it's not too late yet. There have been instances where a few species of butterflies long thought to be extinct have been spotted again. So, it's time to be a little selfless and care for other creatures. By creating a garden for the benefit of butterflies, you will not only bring some of their beauty and wonder into your yard, you will also be helping to ensure the survival of some of these lovely creatures!

Don't make conservatories the only place to find butterflies.

Ms Samiya Fatima, c/o Badruddin Khan, H.No-16-2-55, Akbar Bagh, Hyderabad-500036

Bright Future for Olive Ridley Turtles?

DIVYA KARNAD



A female turtle emerging from the water to lay her eggs.
Photographer: Divya Karnad

The future of the olive ridley turtles would be bright only if lights in the coastal areas were to be dimmed by a shade. Bright lights in and around coastal areas are leading these turtles to their death.

WAVES crash against dark sands as a sea turtle finds a suitable spot on a beach and starts to dig. Its shell camouflages well, but it is possible to discern the distinctive olive ridley turtle. Beaches all across India host these important visitors for a few months of the year. They are ancient mariners who come ashore to lay their eggs.

There are four turtles that regularly nest on Indian shores, namely, the leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), green (*Chelonia mydas*) and the olive ridley turtle (*Lepidochelys olivacea*). Additionally, a few loggerhead turtles (*Caretta caretta*) are also found in Indian waters. The olive ridley is the most widespread nester, coming ashore from the coast of Gujarat to West Bengal. In Odisha, the olive ridley nests in the thousands, in a process called mass nesting.

Under cover of darkness they lay eggs in sand nests that they dig, filling it up and disguising it by dancing atop to flatten and destroy all evidence. They then return to the sea, not to see land again for the next 2-3 years. Over 45 days, the eggs that have been protected by the warm nest, get restless. Baby sea turtles hatch and make their way to the surface, amidst a sea of flippers and eggshells.

Olive ridley turtles do not show parental care and only their instincts help the hatchlings survive. On emerging, they are suddenly exposed to the cool night air, the light of the moon and stars on the water, and the dark shadows of the land.

Clumsy and slow on land, their chances of survival are improved once they make it into deep water. However, they have to face many obstacles before they can reach safety.

Being cold blooded, their body temperature is dependent on their surroundings. Under harsh sunlight, their delicate bodies overheat and desiccate. Their shells are soft, allowing predators like jackals, hyenas, crabs and crows to easily snack on them. Running the gauntlet of these threats, olive ridley hatchlings find the sea using special visual skills. They follow the glow from reflected moonlight and starlight.

Unfortunately, coasts have changed over time. Humans have densely populated beaches and turned night into day, lighting up houses, offices, streets and billboards. The night sky has turned into a nightmare for baby turtles. With an artificially bright horizon in a direction opposite to the sea, olive ridley hatchlings waste precious energy reserves heading in the wrong direction. They are either desiccated by the sun or run-over on roads, if they are not eaten by predators. Generations of turtles will be misled and killed, if nothing is done to reduce night lights.

There have been a few studies on the effects of beachfront lighting on turtles, most originating in the USA. These studies did not focus on how olive ridley turtles perceive light. Indian scientists such as Bivash Pandav, Basudev Tripathy and those from the Odisha Forest Department showed that turtles hatching along the Odisha coast were also affected by light. Yet, there were no studies about what types of light impact, and what could be

On emerging, turtles are suddenly exposed to the cool night air, the light of the moon and stars on the water, and the dark shadows of the land. Their chances of survival are improved once they make it into deep water. However, they have to face many obstacles before they can reach safety.

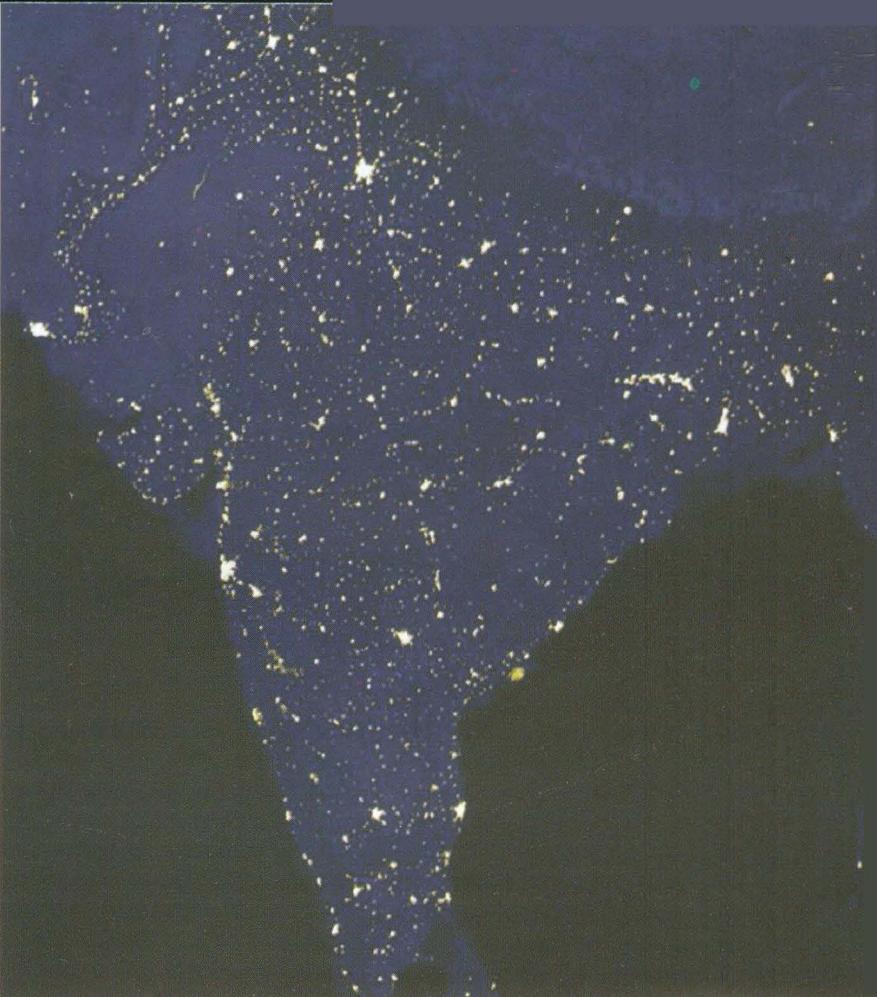
done to reduce their effect. Such studies have become more important in light of the declaration of several coastal SEZ's (POSCO plant) and the development of ports (the one at Dhamra, close to the famous Gahirmatha olive ridley mass nesting beach).

My research work on the Rushikulya mass nesting beach in southern Odisha was focused on the issue of beach lighting and olive ridley hatchling disorientation. This work was done in consultation with Dr Kartik Shanker and Dr Kavita Isvaran, from the Indian Institute of Science and Dr Chandrasekhar Kar from the Odisha Forest Department. We tested lights of different wavelengths (colours) and intensities on the turtles to determine whether they preferentially move towards certain kinds of light. Repeating these experiments on different days, in different areas, we saw a pattern. While light at the higher end of the spectrum, UV and violet, attracted the turtles, lights at the lower end, orange and red, did not seem to affect them. Other species of sea turtles also show this lack of response towards orange-red light.

My study also determined the effect of available light on the hatchlings, and whether they were sensitive to light from great distances. A previous study at Rushikulya had found more than 80% of the hatchlings moving towards the land, in response to light from a single industry within 2 km of the beach. We observed the movements of hatchlings at different locations on the beach, due to lights from a village and a highway, with one section shaded by forest. We saw a difference in the reaction of the little turtles in response to these different lights. The village lights emanating from about 3 km away misguided more than 60% of the hatchlings. The hatchlings also reacted to the occasional well-spaced streetlights from a highway between 4 and 6 km away. Comparing these results to the amount of light we expect from even a medium sized port tells us that the situation is dire.

We must, therefore, find ways to prevent lights from affecting turtles. During the study, we tested the effectiveness of the forest and other barriers in cutting lighting on the beach. We found that natural light-masking mechanism, such as coastal forests or tall sand dunes, allowed olive ridley hatchlings to orient naturally and find their way to the sea. Natural beach vegetation not only acts as a sand-dune builder but also deters errant turtles and helps them re-orient towards the sea. Allowing natural sand dunes to develop is a good way to protect turtles.

Our study has allowed a greater focus to be placed on the issue of artificial lighting in India and how it could affect the world



NASA's image of India at night indicates how brightly lit the coastal regions are.

Source: http://visibleearth.nasa.gov/view_rec.php?id=1438

of our nocturnal animals. Small steps such as drawing curtains or turning off outside lights in beach houses will prevent light from spilling onto the beach, using monochromatic bulbs at the lower end of the spectrum (orange, red) will also help night-loving wildlife such as sea turtles. Allowing beach vegetation to build sand dunes and preventing sand alteration will help. Ports or industries could use lightproof walls or screens, as well as lampshades that mask light on the seaward side to contain artificial light. By modifying the wavelength of the bulbs to monochromatic orange and encouraging ground-embedded lights on roads we will see a significant decrease in disoriented hatchlings.

These simple solutions require planning and commitment to implement, and they have already begun. The Dhamra Port Authority has agreed to use more turtle-friendly lighting in their premises. The Chennai Corporation has agreed to shut off bright beach lighting during the turtle-nesting season. Further government action should be encouraged by citizens. As awareness of this issue grows, citizens should encourage each other to act against brightly lit beach houses or coastal roads. Together we can plan for a dimmer future to ensure some hope for threatened species such as the olive ridley turtle.

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Mysterious Migration

Migrating birds

Scientists are still trying to unravel the mysteries of bird migration. But increasing encroachment on habitats and man-made structures are making migratory birds lose their track.

THE Arctic Tern covers a distance of over 17,000 km every year and the Pacific Golden Plover crosses open seas with non-stop flights of at least 3200 km! And most species of Penguin cover over 1000 km by swimming regularly! Among the many mysteries that man has been trying to unravel since long, bird migration occupies the pride of place.

Most animals tend to migrate generally in specific periods chiefly due to changes in food availability, habitat and weather. Bird migration too seems to be guided by similar considerations. Lands Borough Thomson describes bird migration as "changes of habitat periodically recurring and alternating in direction, which tend to secure optimal environmental conditions at all times." Alternating, back and forth movement,

is a crucial feature of migration. Irregular and generally unidirectional movements are known as nomadism or invasions.

Although factors like changes in food availability, habitat and weather are responsible for migration, the changing seasons also stimulate the internal and external reflexes in the birds. Sunlight has a significant impact over many physiological processes. Hence, variation in day length is supposed to be one of the primary external stimuli. However, manipulating day length artificially in laboratory has been found to provoke stages of maturity of reproductive organs, suggestive of internal stimuli.

Generally, in summer birds migrate towards the north for breeding and return during winter to the warmer southern regions. The extended day length in

summer in the northern part induces birds to breed more. Since day length has significant effect over clutch size or the number of eggs, the extended daylight hours induce diurnal birds to produce larger clutches as compared to non-migratory species of birds in the same region. In autumn, when day length reduces, the birds return to the warmer regions for food.

Patterns of Migration

Often, the bird has to change its locality due to local conditions only. These conditions may be heat, drought or floods, which generally cause adverse effect on the availability of their food supply. In India, at the base of the foothills of the Himalaya, such seasonal changes are more common as compared to the equatorial regions.

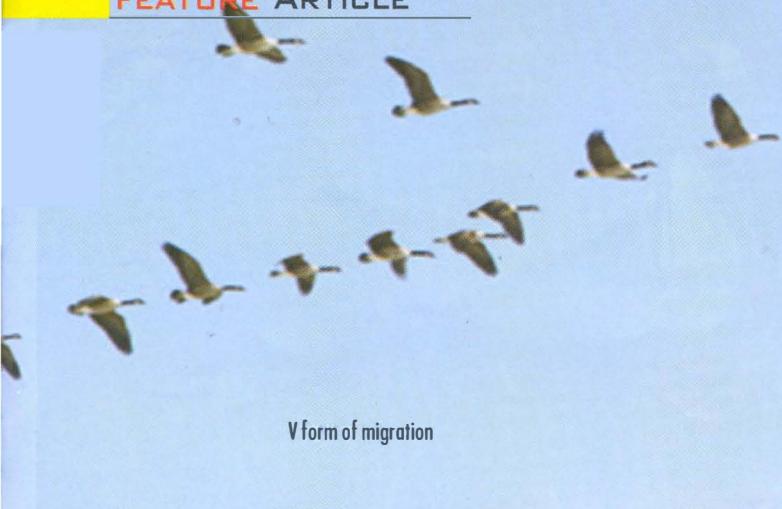
Arctic tern covers 17000 km/year



Grey wagtail



Besides legal efforts like bird sanctuaries, some areas in the country are also protected by people.



V form of migration



Critically endangered Siberian Crane

In a bio-diverse country like India, where different seasons provide various types of food for the birds, local migration is common. For example, the flowering season of certain plants lures the nectarivorous birds like Sunbird. Similarly, the ripening of certain fruits and fluctuations in insect population will attract frugivorous birds like Bulbul, Parakeet and insectivorous birds like Egret, Oriole, respectively. The same bird may be found in summers in a particular locality and in winter or rainy season in a different region. This periodical appearance is also known as local migration.

However, not all birds of the same species migrate necessarily. Only a part of the population within a species may be migratory, this is known as partial migration. Surprisingly, sometimes birds at higher latitudes tend to be migratory whereas those at lower latitudes tend to be resident due to suitable wintering habitats. This type of migration is known as leapfrog migration.

Different altitudes also provide variation in food availability forcing birds to migrate. Such altitudinal migration is common in the Himalayan region in India. At a height of 5000 m (16400 ft.) on the Khumbu glacier of Mt. Everest, the skeletons of Pintail and Black-tailed Godwit found give clues about altitude of migration. The Bar-headed geese have also been observed flying over 8000 m (29000 ft.) in the Himalayas. Sea birds migrate at low altitudes over water and high altitudes when crossing the land. Exactly the opposite type of flying altitude is observed in land migratory birds. Most of the birds migrate in the range of 150 m (500 ft.) to 600 m (2000 ft.).

Different patterns of migration are also based on age groups and sex of the bird. In case of Chaffinches in Scandinavia, only females migrate and males stay as resident. Many larger birds fly in flocks. It helps to reduce the energy stress. Most large birds fly in a V-formation.

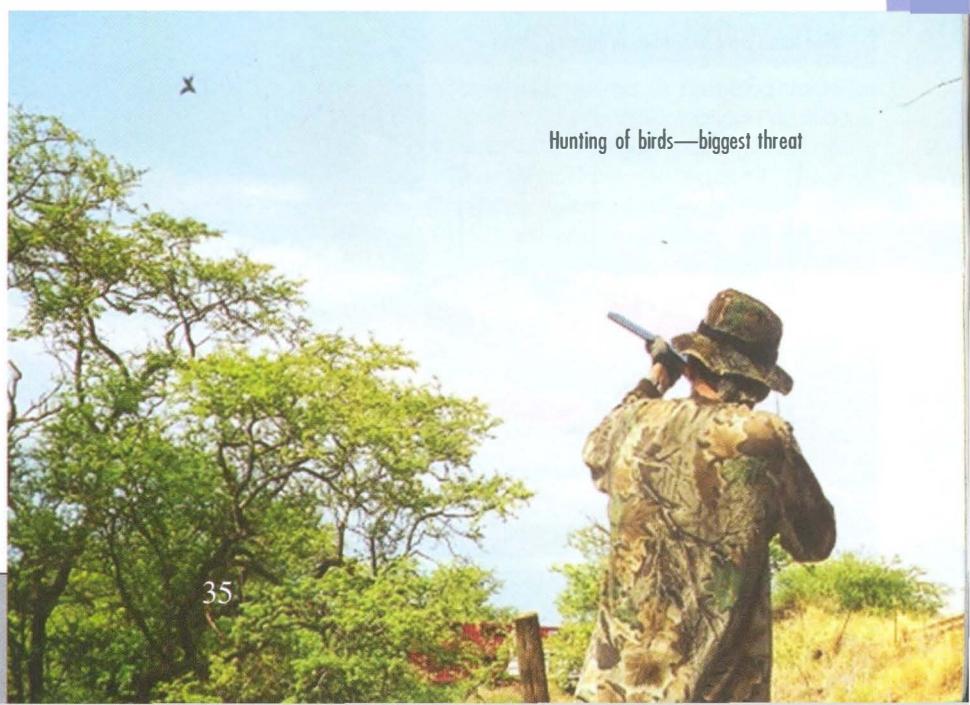
It is observed that, migratory birds return not only to the same general locality for breeding, but also to the same nesting sites year after year. Even after covering a distance of 2000 km or more, the ringed Grey Wagtail was found to return to the same site in Mumbai on the same day!

The Route Map

How do birds find the route year after year? The phenomenon is exciting and mysterious. Generally, the adult males arrive first at their breeding ground in the spring. Adult females arrive later for breeding. However, in autumn, while returning, the adult birds both male and female follow the path led by young ones. Young ones act as forerunners of the flock. Despite having no idea about the route and destination through any previous experience, the flock still manages to reach desired destination accomplishing journey of thousands of miles.



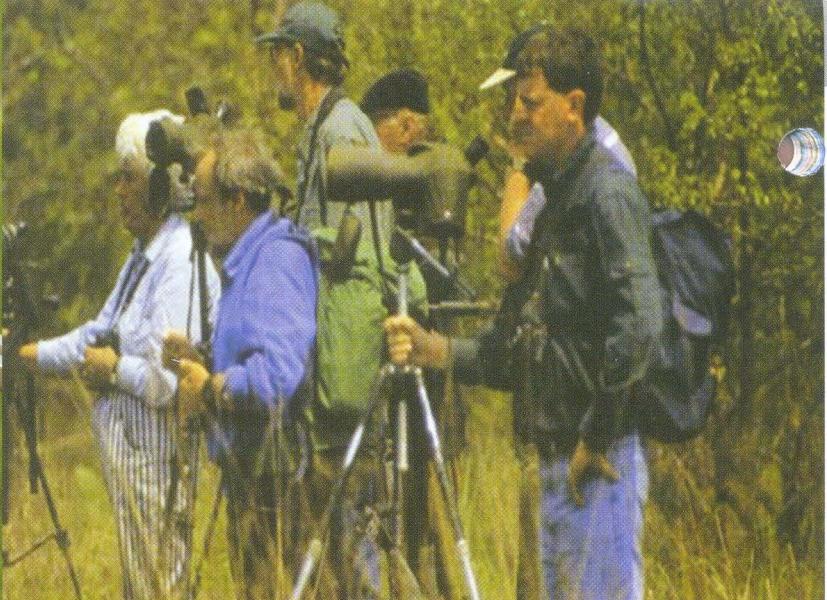
Bar headed goose



Hunting of birds—biggest threat



Ringing the bird



Bird watching—step towards conservation

According to one hypothesis, the route of migration is an embedded primitive trait, which is inborn and inherited through a number of generations that have followed the migratory route. The ability to navigate and orient themselves during the migration is the same as that of genetically fitted programme in birds along with learning.

The change in day length triggers the hormonal reflex in birds, which can be seen with higher activity or restlessness in cage-raised birds. Also prior to migration period, birds show increased fat deposition in the body, which is suggestive of energy storage for migration. Even in caged birds during migration period, a preferential flight direction is seen, which is roughly the same direction of migration shown by wild birds.

Various natural navigators are supposed to guide the path for migratory birds. Day-flying migrants use the sun as a compass by determining their course based on the angle made between the sun and the earth, at a particular time. On the other hand, in case of nocturnal migrants the constellations of stars act as guides. Along with major visual landmarks and olfactory cues, the ability to detect magnetic field by birds equally contributes towards mapping the path.

In fact, young birds in their first migration fly in the correct direction by using the earth's magnetic field. However, they don't have any idea about stopover points. The innate ability and earned experience helps to find electromagnetic fields to recognize the habitats and helps

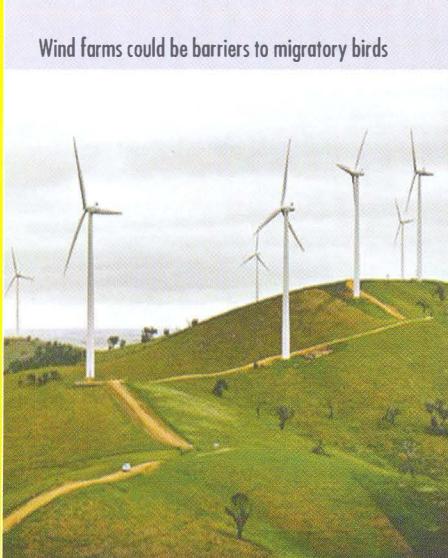
them in making mental maps. Studies on migration of raptors like ospreys and honey buzzards, with satellite tracking has shown that the older individuals are better at making correction for wind drift. Recently, researchers found a neural connection between the eye and fore brain, which is active during migrational orientation.

Problems in Migration

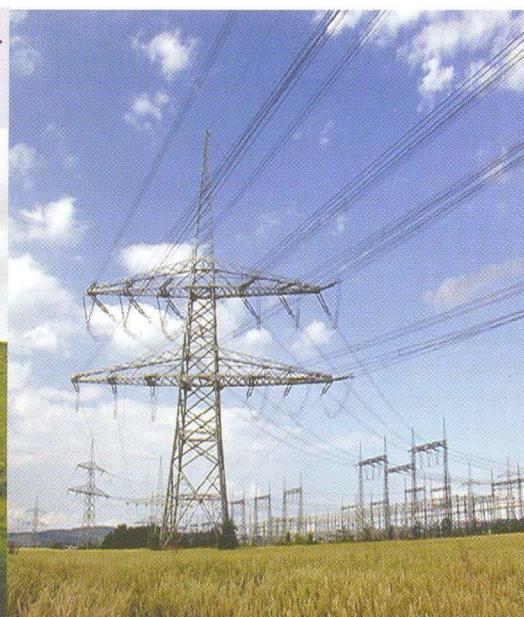
The migratory journey is full of risk, barriers and problems. Apart from high stress, the birds are at risk of predation. This predation risk is the same with diurnal and nocturnal migrants both.

The bird Elenora's falcon feeds its young one with southbound nocturnal passerine migrants. During migration, birds have to stop at some stopover points for

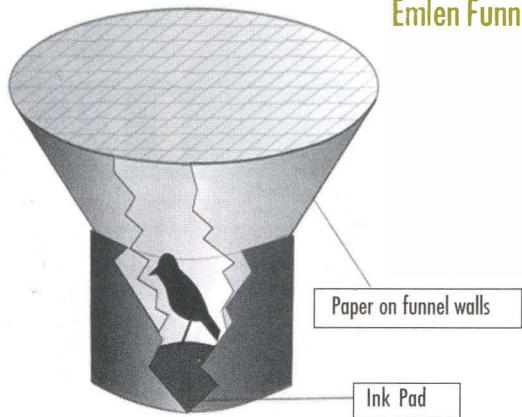
Power lines threatening migratory birds ▶



Wind farms could be barriers to migratory birds



Since the thermals only form over land, these birds are unable to maintain their active flight for long distances and have to face great difficulty in crossing the large water bodies.



Emlen Funnel

In a bio-diverse country like India, where different seasons provide various types of food for the birds, local migration is common.

refueling, which also enhances the predation risk. Many smaller insectivorous birds like hummingbirds and flycatchers migrate large distances usually at night to minimize predation and avoid overheating. Again, nocturnal migration is at the cost of loss of sleep, affecting the migrants' journey.

Large broad winged birds like vultures, eagles, buzzards and stork rely on thermal columns of rising hot air to enable them to soar during the daytime. Since the thermals only form over land, these birds are unable to maintain their active flight for long distances and have to face great difficulty in crossing the large water bodies.

Similarly, water birds have difficulty in crossing the large landscapes. Environmental fluctuations provoke food scarcity that may be harmful. Sometimes, differential wind conditions may cause detours. Various parasites and pathogens causing harm to the immune status of birds cannot be neglected at the same time.

Ecological Effects of Migration

Migration of species from one place to the other is not merely a matter of movement; it also favours the movement of ecto-parasites like ticks and lice. Such ecto-parasites are not only harmful to birds but also serve as host for many vectors like microorganisms, threatening human health.

Many times, some viruses (e.g. West-Nile virus) are maintained within bounds without any lethal effects. But migratory birds can act as carriers for various infections, such as the global spread of avian influenza, which is dreadful to domestic as well as pet birds. Migrants also have an important role in dispersion of

plants and plankton. Migration also changes the gene and genotypic frequencies in the population.

Techniques to Study Migration

Ringing is the oldest method used to obtain knowledge about the migration patterns in birds. Some other techniques like colour marking, use of radar, satellite tracking and stable hydrogen isotopes are also used.

Various efforts to study orientation behaviour have been carried out since several years. For instance, an Emlen funnel is a bird cage shaped like an inverted cone, used to study bird behaviour, in particular birds' migratory instincts. An ink pad is placed on the bottom, so that when the bird hops or flutters onto the sloping walls it leaves a track before slipping back down again. The bird's view through the top of the cage can be manipulated, for example, to know how it responds to different apparent "star patterns" (actually generated in a planetarium).

Conservation

Increased human encroachment in the natural habitats of all birds, not just the migratory birds, has led to widespread habitat destruction. Hunting, fragmentation, illegal trades, poisoning, emerging diseases and climatic changes are also threatening various species of birds.

Conversion of forests and grasslands to agriculture, monoculture plantations in natural forests, grazing and woodcutting pressures etc. have led to a decline in quality and quantity of habitat. This is true for both aquatic and semi-aquatic species. Diversion of surface and ground water, drying up of streams and other water bodies, siltation, pollution from

pesticides and chemical effluents have also threatened the survival of migratory birds.

Man-made structures like power lines, wind farms, offshore oil-rigs and hunting along migratory routes have severely affected migrants. Migration of a huge flock of billions of passenger pigeons (*Ectopistes migratorius*), 1.6 km wide and 500 km long, passing in the sky is now becoming history. This bird has gone extinct already.

Various countries have accepted and adopted conservation measures co-operatively, as the migratory birds cross political boundaries, to protect migratory birds, for instance, the Migratory Bird Treaty Act-1918 of the U.S. and the African Eurasian Migratory Water Birds Agreement.

The extremely biodiverse land of India is also a favourite destination of the migratory birds. Almost 13% of the world's bird species are found in India. Even though there are more than 1200 species of birds in India, it is also the largest country containing rare and threatened species. More than 500 protected areas and 35 areas have been especially established for bird protection. Many migratory birds unfortunately are getting added to the threatened list.

Twelve species are facing the threat of extinction as they have already been categorized 'critically endangered', for example, the Siberian crane. The Keoladeo National Park in Rajasthan has been a favoured spot for the Siberian cranes. But they were last seen in 2002 here. It was found that there was severe hunting along the migratory route, particularly in Afghanistan and central Asia.

Besides legal efforts like bird sanctuaries, some areas in the country are also protected by people. These areas have also served as breeding tracts for many migrants. Vedanthangal (Tamilnadu), Nelapattan (Andhra Pradesh), Kokkelabelur (Karnataka), Navegaon bandh (Maharashtra) are a few of them.

Only when more such legal as well as civil movements and measures are put into place will the migratory birds be once again be able to find their way back to healthy habitats.

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Guar plant

Promise of Guar meal

S. SRIVASTAVA, ANEES K. and R. RAMANI

GUAR, *Cyamopsis tetragonoloba* (Family Fabaceae), is a drought-tolerant summer annual legume mainly grown in the Northwestern part of the country, which includes the states of Rajasthan, Gujarat, Haryana and Punjab. Other main guar producing countries are Pakistan, U.S.A. and Brazil. India is the single largest producer and exporter of guar gum accounting for more than 80% of the global output and trade.

The country exports over 250000 tons of guar gum. The net worth of Indian export is estimated over Rs 1300 crores. There is a large demand from the petroleum industry and oil drilling industries because relatively at low concentration guar gum gives high viscosity. Guar has now assumed a larger role among the domesticated plants due to its unique functional properties.

Guar gum is one of the best thickening, emulsifying and stabilizing agents. In food industries, guar gum is used as gelling, viscosifying, thickening, clouding and binding agent as well as for stabilization, emulsification, preservation, water retention, and enhancement of water-soluble fibre content.

The by-product of guar gum industry consisting of the outerseed coat and germ material is called guar meal. The guar meal after gum extraction is a potential source of protein and contains about 35 to 47.5% crude protein, which is one and a half times more the level of protein in

guar seed. The protein content in guar meal is well comparable with that of groundnut oil cake.

At lesser concentrations, it is used as a feed for livestock including poultry. Guar meal contains a few deleterious substances as anti-nutritional factors, such as, residual guar gum and trypsin inhibitor, which makes it unfit for full exploitation in the feed industry. Considering its nutritional potential an effort has been made to document the recent research efforts in relation to nutritional quality of guar meal.

Composition of Guar Seed

Guar seed contains splits (29%), a source of guar gum, derived from the ground endosperm of the guar plant. It is primarily the ground endosperm of guar beans. The guar seeds are dehusked, milled and screened to obtain the guar gum. It is typically produced as a free flowing, pale, off-white coloured, coarse to fine ground powder. The nutritional value of guar seed is given in Table 1.

Guar Meal Composition

Guar meal is a 100% natural agricultural product and is rich in protein and carbohydrate suitable for feeding to ruminants and livestock. It is a high-protein by-product produced during extraction of

galactomannan gum from the guar bean. During the extraction process, two fractions are produced (germ and hull). Germ and hull fractions are usually combined to form the marketed product, guar meal.

Guar meal typically comes in two forms: (a) Guar Meal Churi, which is in powder form and (b) Guar Meal Koma in granular form and their average composition is:

	Guar Meal Churi	Guar Meal Koma
Crude protein	38% Min	50% Min
Crude fat	1% Max.	7% Max.
Moisture	10% Max.	8% Max
Fibre	6% Max.	5% Max.
Sand/Silica	1% Max.	1% Max.

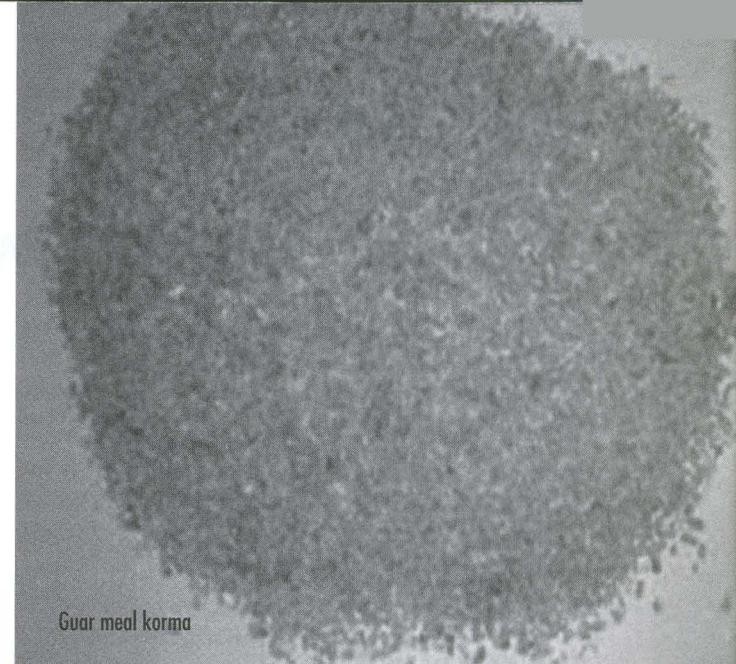
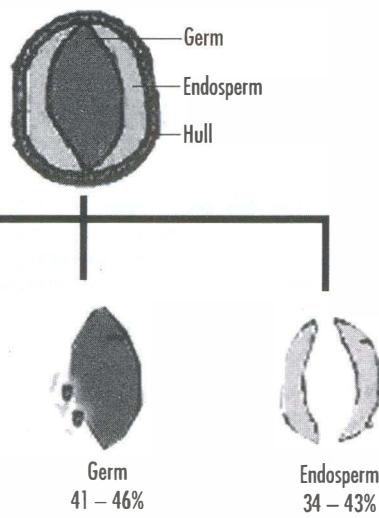
After scrutinizing the earlier reported work, two major parameters, namely, trypsin inhibitor and residual gum, seem to be responsible for imparting the deleterious effects in guar meal.

TABLE 1
NUTRITIONAL VALUE OF GUAR SEED

Part of seed	Protein %	Type of sugar
Hull (13-18%)	5	D-glucose
Endosperm (34-43%)	5	Galactomannan
Germ (41-46%)	55.3	Glucose

Gaur seed Structure

Constituents of
guar seed



The presence of several toxic substances as antinutritional factors (ANF) in guar meal contributes a bitter taste to this abundantly available protein-rich by-product and makes it unsuitable as feed for monogastric animals. Excessive concentration of guar meal in poultry diets causes diarrhea, depresses growth rate and increases mortality of broilers and decreases egg production and feed efficiency of laying hens.

A large portion of this meal remains unutilized owing to the presence of several toxic substances like residual gum, polyphenols, lignins, trypsin inhibitor, saponins, total phenols content, some foul-smelling components, possibly organic acids, aldehydes, and cyanogens.

Research work for the determination of toxic components present in guar meal has been reported by several workers in the past. After scrutinizing the earlier reported work, two major parameters, namely, trypsin inhibitor and residual gum, seem to be responsible for imparting the deleterious effects in guar meal.

Trypsin inhibitor was listed as a deleterious factor because the chicks fed guar meal had been reported to present pancreatic hypertrophy, which can also be found in chickens fed un-heated soybean meal. However, the trypsin inhibitor was not universally accepted as a primary factor for the deleterious effects of feeding guar product to poultry.

The trypsin inhibitor activity in guar meal was reported to be significantly lower than in soybean meal commonly used in poultry which indicates that the negative

effects on performance of poultry when fed diets containing guar meal are not likely due to trypsin inhibitor activity. Rather, the effect is found to have been because of residual guar gum.

Removing Anti-nutritional Factors

Plant phytochemicals exhibit diverse pharmacological and biochemical actions when ingested by animals and humans. Most of the toxic and anti-nutrient effects of these compounds in plants could be removed by processing methods such as soaking, germination, boiling, autoclaving, fermentation and genetic manipulation.

The toxic effects of oxalate, phytate and tannins could be avoided, provided the plant food is cooked before consumption. The trypsin inhibitor values were significantly reduced by the above stated methods, with cooking being the most effective. Soaking of the beans overnight reduced the trypsin inhibitor activity (TIA) by 6.3% and cooking of the soaked beans caused further reduction by 66.7%.

A significant decrease in TIA in winged bean after cooking of the presoaked bean has been reported. Reduction in phytic acid content during soaking, cooking or germination has been reported by many investigators for Chinese legumes, pea, faba bean, dry bean, lentil and black bean, respectively. It was reported that cooking or autoclaving of *Dolichos lablab* seeds reduced the tannin contents by 70% and 60%, respectively. Germination

In food industries, guar gum is used as gelling, viscosifying, thickening, clouding and binding agent as well as for stabilization, emulsification, preservation, water retention, and enhancement of water-soluble fibre content.

significantly increased *in vitro* protein digestibility of *Dolichos lablab* seeds to 92.27%, whereas roasting and autoclaving significantly decreased it to 85.28% and 86.97%, respectively.

Soaking, cooking of presoaked beans and germination are good potential methods for improving the nutritional value of lablab beans by reducing the antinutritional factors such as trypsin inhibitors and phytic acid. Cooking of legume seeds for 30 minutes also destroyed the anti-nutritional factors such as trypsin inhibitors, haemagglutinins, phytic acids, lectins and goitrogens, thereby improving the nutrient availability for better performance of the bird fed such diets.

Upgrading of guar meal is being initiated at the Indian Institute of Natural Resins and Gums (IINRG), Ranchi through detoxification of anti-nutritional factors present in meal by using heat, enzyme and various chemical treatments for utilizing the same in feed industry.

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Sh. Anees K. is a Scientist (Biochemistry) and Dr. R. Ramani is Director, IINRG, Ranchi

PLANT TAXONOMY

- 1. Plant taxonomy is a subject that deals with:**
 - Naming of plants
 - Identification, nomenclature and classification of plants
 - Identification and nomenclature of plants
 - Identification and classification of plants
- 2. Identification deals with:**
 - Determination of a taxon as being identified with or similar to another already known element
 - Classification
 - Nomenclature
 - All of the above
- 3. Carolus Linnaeus system of classification is:**
 - Asexual system
 - Morphological system
 - Sexual system
 - Biochemical and anatomical system
- 4. He was a student of Aristotle and is known as the father of Botany. He was the author of *Historia plantarum*. He classified plants into trees, shrubs, under shrubs and herbs and also recognized annual, biennial and perennial duration of plant life cycle.**
 - Jerome Bock (1498-1554)
 - Albertus Magnus (1193-1280)
 - Andrea Caesalpino (1519-1603)
 - Theophrastus (370-285 B.C.)
- 5. Who had recognized monocotyledons and dicotyledons as separate plant forms?**
 - Otto Brunfels (1464-1534)
 - Carl Linne
 - Charles Darwin
 - Albertus Magnus (1193-1280)
- 6. *Historia plantarum universalis* (1605) in three volumes deals with 5000 plants and was published posthumously by his son-in-law Cherler who is:**
 - John Ray (1628-1705)
 - Joseph Pittonde Tournefort
 - A.P. de Candole
 - Johann Bauhin (1541-1631)
- 7. *Methodus plantarum* (1800 sfs) was published by:**
 - Mario Malpighi
 - Grew
 - Anton van Leeuwenhoek
 - John Grey
- 8. Changes in environment can cause changes in the structure of organisms or evolution of acquired characters. This was proposed by a French biologist and plant taxonomist.**
 - Michael Adanson
 - Jean B.A.P.M. de Lamarck
 - De Jussieu
 - August Wilhelm Eichler (1839-1887)
- 9. Who is known as the father of binomial nomenclature?**
 - Bentham and Hooker
 - Sir Charles Darwin
 - Engler and Prantl
 - Carolus Linnaeus
- 10. Some of the famous publications of Carolus Linnaeus, the father of binomial nomenclature, are:**
 - Flora Lapponica, General Plantarum, Hortus Cliffortianus and Species Plantarum
 - Flora Francoise
 - General Plantarum
 - Die natürlichen Pflanzen-familien (1887-1899)
- 11. In binominal nomenclature the first epithet is the:**
 - Epithet for the family of the plant and the second is for the order of the plant
 - Epithet for the genus of the plant and the second is for the species of the plant, third if any is for variety
 - First is for the species and the second is for the genus
 - First whether the plant is a monocotyledonous and the second is for the species of the plant
- 12. This famous plant taxonomist was in the Royal Botanic Garden Kew, England. His publication of 1926 and 1934 was "The families of flowering plants". His method of classification has closer affinities with that of Bentham and Hooker.**
 - Alfred Barton Rendle
 - Karl Christian Mez
 - Hans Hallier
 - John Hutchinson
- 13. Who coined the term 'species'?**
 - John Ray
 - Oswald Tippo
 - Carolus Linnaeus
 - C. Bessey
- 14. Who was the famous embryologist who said that 'Ontogeny repeats phylogeny'?**
 - Lamarck
 - Von Baer
 - Louise Pasteur
 - Sir Charles Darwin
- 15. Phylogeny is the:**
 - Life cycle of a species
 - Evolutionary history of a taxon
 - Ontogeny of a plant/animal
 - All of the above
- 16. Which group of biologists/scientists were not plant taxonomists?**
 - Darwin, Cuvier, Steward
 - Bessey, Rendel, Ray, Gray, Hallier
 - Mez, Hutchinson, Linnaeus, Wettstein
 - Engler, deCandole, Jisseau, Wettstein
- 17. Cytology and cytobotany are studies that until now have remained valuable in plant taxonomy since these can be useful:**
 - In establishing families of plants
 - In the phyletic resolution of taxa below the level of genus
 - In separating monocots from dicots
 - In separating angiosperms from gymnosperms
- 18. The world's most primitive angiospermic plant is:**
 - Ophioglossum
 - Ficus sp
 - Lotus
 - Amborella, a relative of water lily
- 19. *Critica Botanica*, *Fundamenta Botanica* and *Philosophia Botanica* are the three works on plant taxonomy by:**
 - J.D. Bentham and Hooker
 - Carolus Linnaeus
 - Engler and Prantl
 - Eichler
- 20. Botanically a plant has to have:**
 - Two names such as first one for the genus and the second one for the species
 - Three names
 - None of the above
 - Nomen nudum only
- 21. In numerical taxonomy:**
 - Classification is based on genetic similarity
 - Viewing the nucleotide sequences of rRNA and DNA
 - Phenetic similarity and taxonomy is viewed as an empirical science and a priori each character is taken as of equal weight
 - All of the above

ANSWERS

1. b	2. a	3. c	4. d	5. d	6. c	7. d	8. b
9. d	10. a	11. c	12. d	13. a	14. b	15. b	16. a
17. b	18. d	19. a	20. a	21. c			

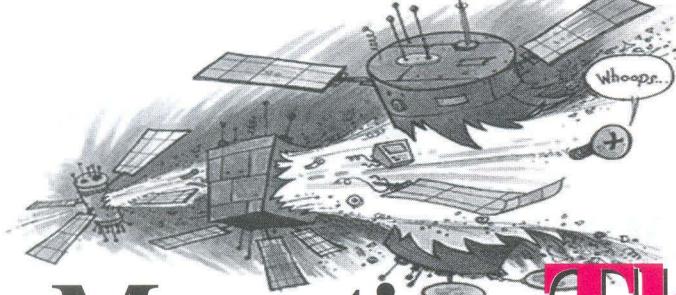
Contributed by Mr. Auobindo Satpathy, Lecturer in Botany, Dasharathpur H.S. School, Jajpur, Odisha

THE PERIODIC TABLE

ANSWERS

1)a 2)b 3)d 4)d 5)d 6)d 7)c 8)d
9)b 10)a 11)d 12)b 13)b 14)c 15)c 16)c
17)c 18)b 19)a 20)c

Contributed by Sabdar Aman Chowdhury, Assistant Professor, Department of Chemistry, Bolpur College, Bolpur, Birbhum, West Bengal-731204; E-mail: sabdarac@hotmail.com, Address: "Senjuti", Digantapally, P.O.-Santiniketan, Dt.-Birbhum, West Bengal-731235.



Mounting Threat of Space Debris

Junk in outer space is threatening space missions like never before. And scientists are coming up with really innovative solutions to clear the mess created up there.

In late September this year, the six tonne class Upper Atmosphere Research Satellite (UARS) of the National Aeronautics and Space Administration (NASA) of USA disintegrated and fell back to earth over a location that could not be identified. In fact, the reason why the exact spot of a satellite crash is hard to predict is because the density of the atmosphere, especially in the upper regions, fluctuates violently, producing different amounts of drag.

This satellite, which ran out of onboard fuel in 2005, was launched way back in 1991 with the objective of measuring ozone levels, wind speeds and temperatures in the stratosphere. But the extent of debris it has contributed to the space pollution belt in the near earth orbit is yet to be quantified. All said and done, the disintegration of UARS was a grim reminder to the ground reality that pollution is not an exclusive problem nagging our spaceship earth.

For quite some time now, most space agencies have been expressing serious concern over the mountain of debris in outer space posing a threat to multi-million dollar satellite missions. Not surprisingly then, a meeting of the Inter Agency Space Debris Coordination Committee (IADC) held in Berlin earlier this year came to the conclusion that extraction of up to five larger debris each year would be essential to keep outer space safe for operational satellites. As pointed out by Matthew Hoeg, Director of the US-based Military Space Transparency Project (MSTD), "In terms of clean up, it is critical that military forces,

government agencies and the private sector work together as part of a broad based international coalition." In the ultimate analysis, there is unanimity of view on the need to actively remove some debris from orbit.

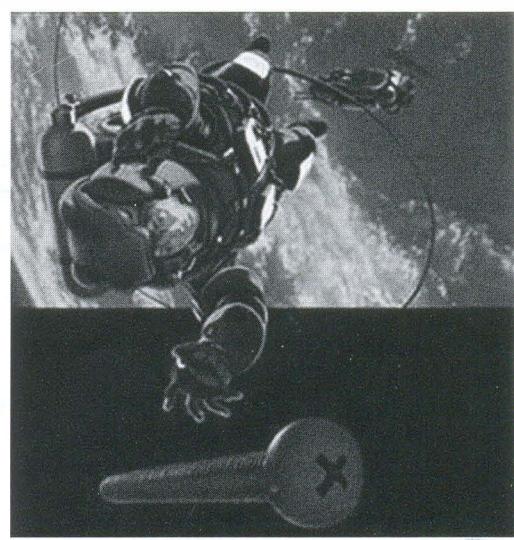
Since the ushering in of the space age more than five decades back, an exponential growth in launch activities has resulted in the littering of near earth orbit with fragmented parts of satellites and launch vehicles on a sustained basis. According to one estimate, there are now more than 22,000 objects in the space junkyard that are big enough to be tracked. They travel at speeds up to 17,500 miles per hour and could easily damage an operational satellite. In addition, there are countless smaller objects that are not amenable to tracking. Nicholas Johnson, NASA chief scientist for orbital debris points out, "The greatest risk to space missions comes from non trackable debris."

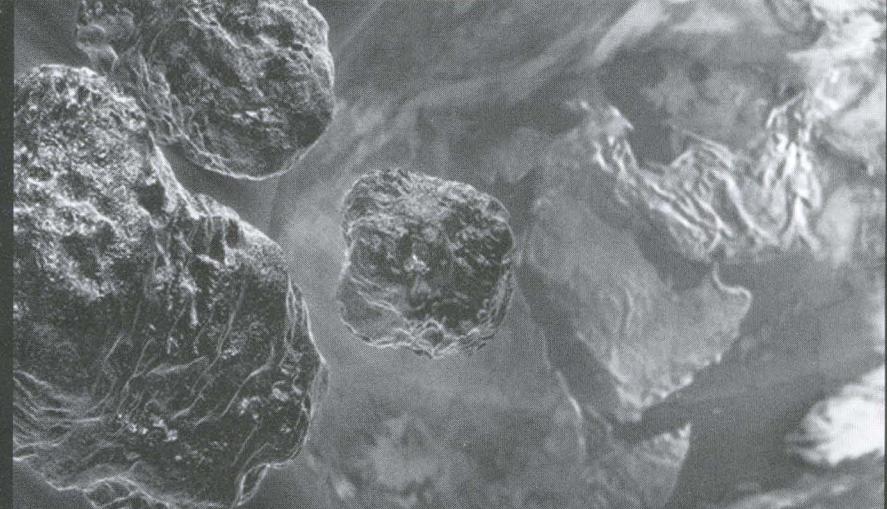
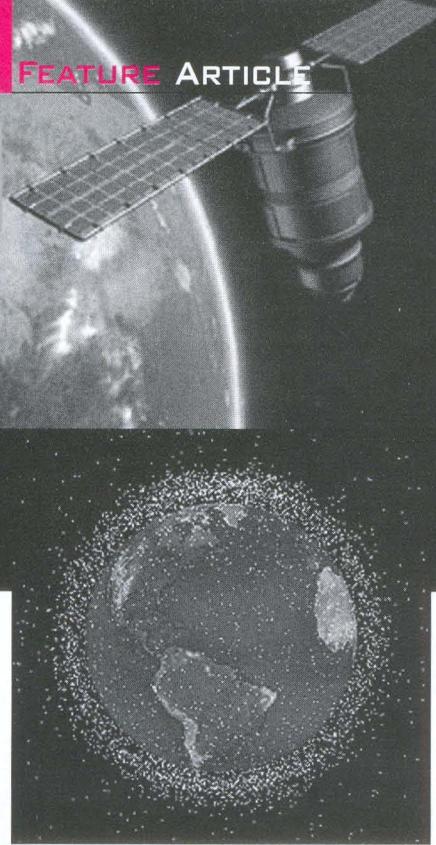
In the rapidly piling up mountain of space debris can be found nuts, bolts, electrical and electronic devices from disintegrated satellites and launch vehicles as well as cameras, screw drivers, food cans and oxygen cylinders left behind by astronauts. Not surprisingly then, space experts are a worried lot over the threat posed by space debris to the multi-million dollar satellite missions and manned probes.

There is no denying the fact that space junk is a risk factor for more than 1,000 operational commercial, military and civilian satellites orbiting the earth. Indeed, a fact-filled study by the National

Research Council (NRC) of US points out that the growing volume of space junk in near earth orbit has reached a "tipping point" for collision. As such, the NRC report makes a strong case for the space agencies to devise new and innovative strategies for mitigating the hazard posed by space debris. Of course, experts who have called for cleaning up the "dirt and debris" in near earth orbit, are exploring various strategies to realize the objective.

Researchers say that many pieces of satellites and launch vehicles continues to stay in orbit indefinitely if they attain what is called the first cosmic speed. Only objects that slip below an altitude of 120-150 km re-enter the atmosphere to blaze down as unidentifiable pieces on earth. The collision hazard posed by the space





Deploying large nets to collect debris or firing harpoons to drag unfunctional satellites back to earth are yet to take off.

enhance the risk of spacecraft failure. "The current space environment is growing increasingly hazardous to spacecraft and astronauts," points out Donald Kessler, the former head of the orbital debris programme office of NASA. On the other hand, the NRC report notes, "the problem of space debris is similar to a host of other environmental problems and public concerns characterized by possibly significant differences between the short and long range damage occurring to the society".

Nonetheless there is a growing worry over the possibility of the space debris problem getting more pronounced in the context of increasing launch activities. According to space industry estimates, while an average of 76 satellites per year were launched over the last ten years, in the coming decade the activity would grow by 50%. According to an analysis by Euroconsult, some 1,145 satellites would be built for launch between 2011 and 2020.

What is more, the hazardous aspect of space continues to engage the attention of the global space agencies. Indeed, the dangers involved in space exploration were conspicuously highlighted by the melodrama that accompanied the uncontrolled descent of the American Skylab. This episode triggered a sort of global panic. Luckily, and to the great relief of the earthlings, the Skylab made a soft landing in the waters off the Australian coast in July 1979. Quite recently, in February 2008, an American defence satellite that had lost its orientation and started tumbling menacingly towards the earth was destroyed in mid space by a missile fired from a US naval vessel.

Overcrowding is another worrisome problem plaguing outer space. The vital slots in the so called geostationary orbit—36,000 km above the equator where a satellite appears stationary in relation to earth—often referred to as a real estate of the final frontiers, are fast getting filled, thereby raising the serious issue of interference between the satellites. Not long back, a couple of Latin American countries had staked their claim on many slots in this prized orbit for the simple reason that they were located right above their geographical expanse.

Meanwhile many innovative ideas are being mooted to clean up the fast piling volume of debris in outer space. One idea is to launch robotic missions directed at realizing a controlled re-entry of individual pieces of debris including dead satellites. Similarly, suggestions such as deploying large nets to collect debris or firing harpoons into defunct satellites to drag them back to earth are yet to take off. The European Commission on its part has mooted a space policy aimed at setting up of an autonomous European space situational awareness system to track debris.

Pointing to the various suggestions made for removing debris from outer space, Hugh Lewis of the aerospace engineering department of Southampton University in UK observes, "I think we are a long way off from having something which is reliable, relatively risk free and relatively low cost. There are a number of outstanding and fundamental issues that we still have to resolve."

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debris is mainly due to the high-energy impact caused by its rapid acceleration.

Significantly, the first confirmed collision between two catalogued objects took place in July 1996 when the gravity gradient altitude control boom of the French defence satellite Cerise was damaged by a fragment from an Ariane launch vehicle of the European space transportation company, Arianespace. However, the first ever "smash up" in outer space occurred in 2009 when a fully operational American communications satellite Iridium was destroyed following its collision with a defunct Russian satellite designated Cosmos-2251. This space mishap, which took place 789 km over Siberia, generated thousands of pieces of debris. And in March this year, the International Space Station (ISS) narrowly escaped being hit from the debris of this 2009 collision.

According to US Space Surveillance Network, the early 2007 anti satellite test by China, which involved the destruction of an aging weather watch satellite FENGYUN-1 by means of a medium range ballistic missile, contributed in a substantial manner to the space junkyard. The NRC report also drives home the point that computer models have gone to show that the amount of orbital debris has "reached a tipping point" for collisions and create even more debris and in the process

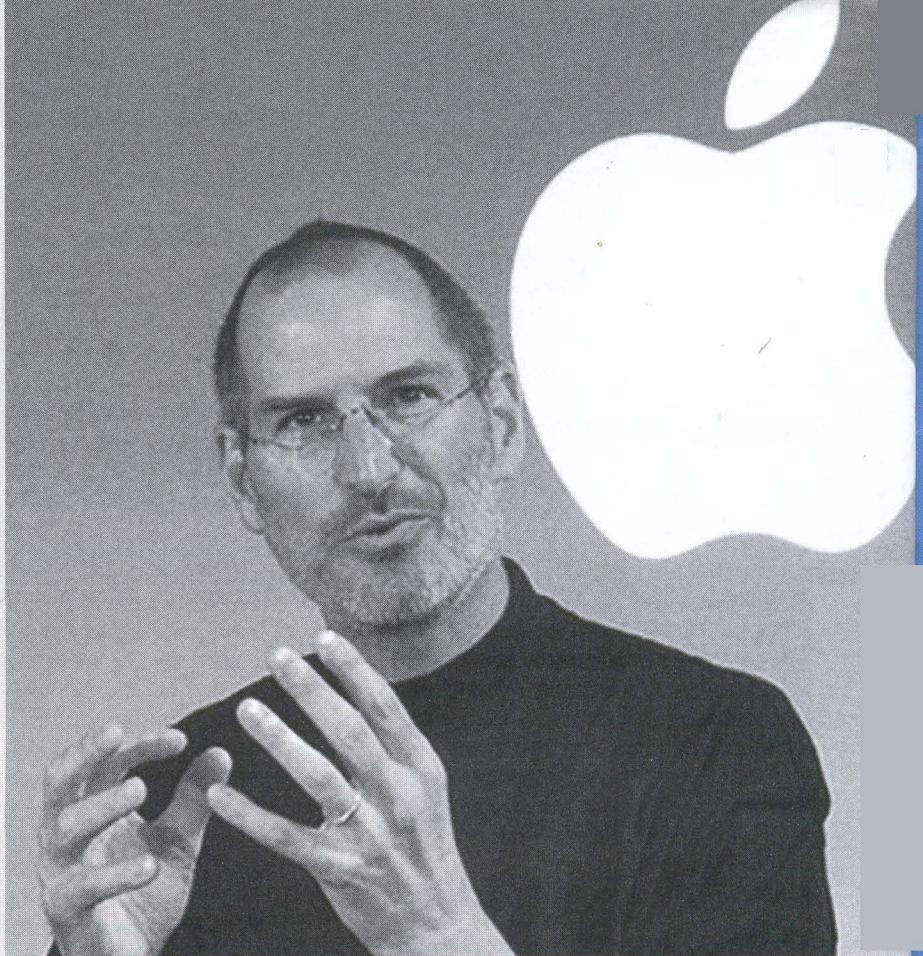
Will Steve Rest In Peace?

S.G. SEETHARAM

I am quite aware of the extent to which millions of people across the world are attached to Apple's "i-gadget" family (almost like adaptors, connectors, or chargers), and can therefore sense the depths of their shock and sense of disconnect at the tragic passing of the "i-guru" – Steven Paul Jobs. In fact, many of them received the news of Steve's death on one of his own inventions, which made their grief all the more poignant.

Although I am an unrepentant and incorrigible "i-illiterate", I found myself inescapably drawn to Steve, back in the late 1980s, when I saw the first Mac of my life at an air-conditioned DTP bureau in a city in southern India. Mac's GUI, icons (in place of nasty chains of command), colour graphics, mouse, feather-touch keyboard ("Life is smoother since we can touch instead of push"), sleek design and several other cool features struck me like some strange magic, and I can recall times when Mac was the apple of the computer world's "i," and its SA (Sex Appeal) and price-tag were so high that snobs would carry Mac just to make a fashion statement.

But, in my case, more than the machine itself, its prodigious maker mesmerized me, and Steve breaking conventions impressed me more than Steve making inventions (or reinventions). Steve's traumatic early childhood experiences, particularly his unwed parents giving him up for adoption; his dropping out of college; his passion for calligraphy and typographic fonts; his garage start-up; his conversion to Zen Buddhism (and consequent head-shaving); his counterculture experiments; his dismissal from his own Apple Computers; his counter-challenge to cancer (the rebel's own cells rebelled against him, and in the beginning, he shunned mainstream medicine) – there was nothing about him, in style as well as substance, that was not sensational and maverick.



Steve's traumatic early childhood experiences, particularly his unwed parents; his dropping out of college; his passion for calligraphy; his garage start-up; his conversion to Zen Buddhism; his counterculture experiments; his dismissal from his own Apple Computers....

In my view, Steve was more an iConoclast than an iCon, and I loved seeing him defying tradition more than defining tastes and trends. To me, Steve was a person of transterrestrial brilliance, and an archetypal representative of an uber-smart technological civilization to come.

What "NeXT"? Maybe some insanely ingenious nerds will keep Steve-the-Geek's celebrated inventive legacy alive, and present the world with i-peds, i-pids, i-puds, and other game-changing gizmos to carry users' sensory experiences still deeper. But, I personally look forward to the advent of a "pan-creative" Steve-like genius who will present a cure for pancreatic and other pernicious cancers. Also, I anxiously anticipate the emergence of a Pixar that can physically reanimate the likes of Steve Jobs!!

It is now time to wish "RIP" to Steve, but I would prefer to refrain from doing so, because I know Steve is not the type to ever "rest in peace." Indeed, he will already be trying to i-connect to his successors from his pad in "outer cyberspace"! Steve will always stay logged in to the memory systems of his countless fans, and his life and mind will continue to inspire them as long as history lasts.

Contributed by Mr S.G. Seetharam, 1119, Gita Road, Mysore-570005;
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WETLANDS are under tremendous threat and so are their dwellers.

There are several factors responsible for this, such as fragmentation, encroachment, rehabilitation, conversion, urbanization, eutrophication, and pollution. Alarmingly, seasonal wetlands in India are also threatened and disappearing very fast because of the sandwich pressure of tremendous human intervention and climate changes, including erratic rainfall and global warming.

Loss of these wetlands is really a cause for worry; for they provide a colossal amount of easily available protein foods to those who eke out their livelihood from these wetlands by catching a wide range of wild fishes. But the populace living

around these wetlands have been treating these wetlands as their own 'Food Bank', catching much more fish than is being replenished.

What are Seasonal Wetlands?

Now, what are seasonal wetlands? Areas that remain submerged for 5-6 months, with water depth in the range of 0.25-1.0 meter in general, and up to 1.5 meter in certain regions during the post monsoon period are usually christened 'Seasonal Wetlands'. With particular reference to eastern parts of India, 40,000ha in North Bihar, 46,000ha in West Bengal, and the entire plain land about 1, 00,000ha in Assam turn into seasonal wetlands every year during the rainy season thanks to the South-west monsoon.

These seasonal wetlands are known by various names in different states, such as beels, chaura, hoars, baors, jheels, mans, tals, pats, karanjali, and dhars. They mainly include floodplain areas, flash flood areas, back swamps, sloughs, etc., which are usually cut-off river meanders (oxbow lake) due to tectonic depressions. Submergence of these areas is prolonged because of three main reasons: (i) stagnation of rainwater, (ii) overflow of river water, and (iii) shallowness of the area.

With the arrival of the monsoon after prolonged summer months, saturated with rainwater, dry lands become converted into semi-aquatic environment that provides suitable habitat for a wide range of aquatic organisms such as microorganisms, microbes, phytoplankton, periphyton, benthos, macrophytic zooplankton, and macro fauna like

Seasonal wetlands need to be nurtured for the wealth of high quality nutrients they offer and also as future sources of freshwater.

Nurturing Wetlands

R. N. MANDAL





Wetlands are a good source of nourishment of high biological value

insects, snails, fish, etc, which find ideal conditions for breeding, spawning, rearing and maturation.

The areas where seasonal wetlands exist every year are witness to cyclical events performed by organisms. During dry months the life forms of biota existing in the same place reveal different habits as compared to those occurring in wet habitats.

In such context, seasonal wetlands usually contribute to the dynamics of trophic system leading to higher productivity because of certain reasons such as:

(i) Flooding provides adequate water supply for the aquatic vegetation, which generates oxygen by way of photosynthesis.

(ii) Nutrients are supplied and favorable alteration of soil chemistry occurs due to

dynamic system by water flow; these alterations include nitrification, sulfate reduction and nutrient mineralization.

(iii) Amount of nutrients increases attributed to litter decomposition and thus seasonal wetlands become nutrient-enriched.
(iv) Rapid leaching of soluble organic carbon occurs from existing soil bed and then erosion as well as transport of particulate organic carbon takes place by means of water flow.

(v) Flowing of water offers a sufficient amount of oxygenation since water flow carries away many waste products of soil and root metabolism such as carbon dioxide and methane.

Dissolved carbons are important source of energy for microorganisms, which, in turn, convert it to particulate form. This particulate carbon enhances wetland productivity. After flooding, chemical

features of water undergo gradual changes that continue until the water recedes. This includes availability of dissolved oxygen and the pH of the water, which in turn determine biological activities such as photosynthesis and respiration. Dissolved oxygen and pH of the water facilitate survival of fishes and other organisms in seasonal wetlands

Nitrogen, phosphorus and potassium as primary nutrients stimulate phytoplankton production. Significantly, phytoplankton is the base of energy production and also food source for other organisms, including fishes. Other trace elements such as sodium, calcium, magnesium and sulphur as secondary nutrients are produced during anaerobic reduction of soil from clay exchange sites. Therefore, more is the entry of rain and floodwater; more is the amount of these nutrients in seasonal wetlands.

The deficit of freshwater supply may be made up by harvesting rain and floodwater that are easily available and stored in seasonal wetlands.

Dynamics of Water Flow

The reproductive biology of different aquatic organisms synchronizes to get activated at the onset of monsoon rain. Entry of overflow and runoff water from catchment areas causes fishes to become induced to synchronize their reproductive cycle such as breeding, hatching and spawning. As the water flow increases the wetlands slowly become perfectly suited for fish rearing, as they are nourished by the plankton and huge amount of minerals and other substances that rush in with the water.

The different life stages of fishes such as spawn, fry, fingerlings, juveniles, adults, brooders, and breeders have specific feeding requirements, which they extract from different niches of the wetlands. Consequently, fish grow well, get nourished, increase in population and become healthy.

As recorded, about 180 indigenous freshwater fish species distributed in 84 genera and 29 families dwell in seasonal wetlands of the Ganga-Brahmaputra basin. Records indicate that monsoon-fed seasonal wetlands have been rich repository of gene pool of indigenous fish diversity, besides a variety of prawn species.

FOOD RESOURCES OF WETLANDS

Plant resources

Vegetables: petioles & thalamus of *Nymphaea* spp., *Nelumbo* sp., *Alocasia* spp., *Colocasia* spp.

Leafy vegetables: *Ipomoea* sp., *Enhydria* sp., *Alocasia* spp., *Colocasia* spp., *Marsilea* sp., *Alternanthera* spp., *Hygrophila* sp., *Commelinia* sp., *Hydrocotyle* sp.

Rhizome: *Nymphaea* spp., *Nelumbo* sp., *Alocasia* spp., *Colocasia* spp.

Fruit & seeds: *Nymphaea* spp., *Nelumbo* sp.

Animal resources

Crabs: *Paratelphusa* spp.

Mollusks: *Pila* spp., *Gabbia* spp., *Indoplanorbis* spp., *Lamellidens* spp., *Bellamya* spp., *Gyraulus* spp.

Fishes: 180 indigenous fish species, besides varieties of prawn species.



The day is not far when freshwater would be treated as an essential commodity on the same footing as other necessary goods.
let us save the precious monsoon-fed seasonal wetlands, else the crisis of freshwater is inevitable,

But all those indigenous fish species are hitherto under serious threat because of the present trend of injudicious fish catch, loss of wetlands, and excessive use of harmful chemicals during agriculture practice.



Food Resources and Livelihood

Irrespective of the economic class, people living around these wetlands collect a variety of aquatic resources, including wild fish. They get nourished by way of easily available major source of animal protein food of very high biological value. Submerged ecosystems thus play an important role in providing nutritional support for rural folk who benefit by way of easily available important micronutrients from fishes. These nutritious fish food substitute the vegetable food resources that remain scarce during post-monsoon period because of submergence of cropping areas and so vegetables become costly.

Freshwater Harvest

The climate change crisis in the future could seriously impact freshwater availability in the future. This is an alarming prospect for freshwater fish regeneration as well. Construction of reservoirs, tanks, small lakes, etc in order to conserve fresh water is a Herculean task. Rather, fresh



Human intervention has led to strangulation of wetlands

water stored in seasonal wetlands due to rain and flood is a much easier and better option.

Besides, there are growing concerns over already stocked fresh water in different sources like reservoirs, lakes, tanks, canals, and rivers that are either polluted or may not be suitable for fish culture. On the contrary, monsoon fed seasonal wetlands are reasonably clean sources of fresh water to harvest fish. The water quality of seasonal wetlands is very good.

Plight of Wetlands

Direct and indirect human intervention has led to the strangulation of wetlands. Here are a few instances that have led to drastic dwindling of wetlands.

- (i) Gradual increase of heavy metal, pesticides, herbicides, and other harmful chemicals deposited in sludge, water, plankton, benthos, periphyton, and aquatic animals. All these organic and inorganic substances affect human health, mostly through fish consumption.
- (ii) Flow of untreated wastewater emanating from industries and urban areas makes the water bodies extremely polluted leading to eutrophication while

passing through canals and river. Eventually, contamination engulfs the entire vicinity.

(iii) Rapid urbanization attributed to rehabilitation programmes is now rapidly encroaching the already fragmented wetlands. Brick industry is one such threat that has gradually encroached upon seasonal wetlands.

(iv) Erratic rainfall and temperature rise due to climate change make seasonal wetlands vulnerable.

Seasonal wetlands should be maintained on priority basis because of their phenomenal ecosystem services to human beings. The diverse gene pool of fishes can be protected through natural regeneration and that is possible only in the renewable monsoon-fed wetlands. Maintenance of diverse gene pool of fishes brings nutritional security for all, in general, and particularly for those who are economically depressed. Depletion of fish diversity, if not replenished mainly due to prolonged drought or over exploitation, may lead to inevitable problems like malnutrition of the rural poor for whom this ecosystem service is an integral part of their livelihood.

Both habitats and organisms, however, are seriously vulnerable due to habitat loss and fragmentation, injudicious exploitation, pollution from runoff of agricultural chemicals, climate change and global warming.

Apart from that, deficit of freshwater supply may be made up by harvesting rain and floodwater that are easily available and stored in seasonal wetlands. The day is not far when freshwater would be treated as an essential commodity on the same footing as other necessary goods. The most alarming situation is that wetlands like reservoirs, lakes, and tanks may get lost due to the high rate of evaporation due to global warming, human intervention, injudicious use of freshwater and eutrophication, but seasonal wetlands remain will survive as long as rain and flood waters are available.

So, let us save the precious monsoon-fed seasonal wetlands, else the crisis of freshwater is inevitable, boding ill for the entire human civilization.

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ANIMALS & PLANTS SUDOKU

This is the normal Sudoku, except that here the shaded boxes take the name of plants only and the plain boxes take the names of animals only. Fill the grid so that every horizontal, vertical and every 3x3 grid contains names of **five animals** and **four plants**, without repeating any. You cannot change the names already given in the grid.

						CAT	MANGO	LION
DOG								
		COCONUT	PIG			DOG	BANANA	
							PIG	
BANANA								NEEM
	CAT		NEEM	LION			DOG	BANANA
NEEM	DOG		RAT					
CAT	LION							
RAT	COCONUT		DOG			NEEM		MANGO

Contributed by Dr K. Venkatraman, AT2, Palkudam Apartments,
Bypass Road, Madurai-10

There are three prizes of Rs. 500/- each for three correct entries. In case there are a large number of correct entries, the prize winner will be selected through a draw of lots. The decision of the Editor, *Science Reporter*, will be final.

Puzzle Corner
Science Reporter

National Institute of Science Communication And
Information Resources, CSIR, Dr. K.S. Krishnan Marg
New Delhi-110012

Last date for the entries to reach us: 30-11-2011



Your Name :

Address :

..... Pin Code :

Age : E-mail : Sex :

Occupation : Student Housewife Teacher Professional Retired Other

Educational Level: Primary Secondary Graduate Postgraduate

*Please fill up the questionnaire at the back

*Please note: Now you can even send your answers on a photocopy of this page.

ASTRONOMY PHENOMENA QUIZ

Search for names of 20 astronomy phenomena ('ion' ending). They are arranged horizontally, vertically, diagonally and backwards.

S	T	U	U	U	U	S	U	N	O	I	T	A	T	U	N
C	O	N	J	U	N	C	T	I	O	N	T	T	S	T	O
N	P	R	E	C	E	S	S	I	O	N	U	U	K	S	I
O	O	S	S	S	T	K	R	I	O	N	R	P	G	C	T
I	O	I	K	K	T	G	S	I	O	E	R	S	U	I	C
T	C	K	G	G	U	R	S	I	F	O	S	N	A	N	A
I	C	G	U	N	E	R	T	L	P	N	O	B	O	T	R
S	U	U	R	M	E	A	E	E	O	I	E	I	R	I	F
O	L	R	E	M	L	C	R	I	T	R	T	K	N	L	E
P	T	T	M	O	T	M	S	A	R	A	K	G	O	L	R
P	A	I	S	I	O	S	N	A	R	G	G	U	I	A	K
O	T	N	O	T	E	I	T	B	T	U	U	R	T	T	G
K	I	N	I	R	M	I	I	U	K	H	R	S	A	I	S
G	O	O	G	L	O	L	T	S	K	R	G	K	T	O	K
U	N	E	U	N	E	L	O	N	G	A	T	I	O	N	S
R	R	C	T	N	O	I	T	U	L	O	V	E	R	S	K

Contributed by Dr. S.K. Gurtu, 80/158, Mansarovar, Jaipur-20

SOLUTIONS TO PUZZLES PUBLISHED IN THE SEPTEMBER 2011 ISSUE

PRIZE PUZZLE:

JUMBLE WORDS

1.PLASMID	2.ENZYME	3.FUNGI
4.MICROSCOPE	5.PHAGE	6.SLIMY
7.CAPSULE	8.LAYER	9.SKIN
10.MATTER	11.VIRUS	12.VEGETATIVE
13.FLAGELLA	14.SUGAR	

15.PROTEIN (**PS:** Option 11 was wrongly spelled; this has been taken into consideration while screening for the correct entries)

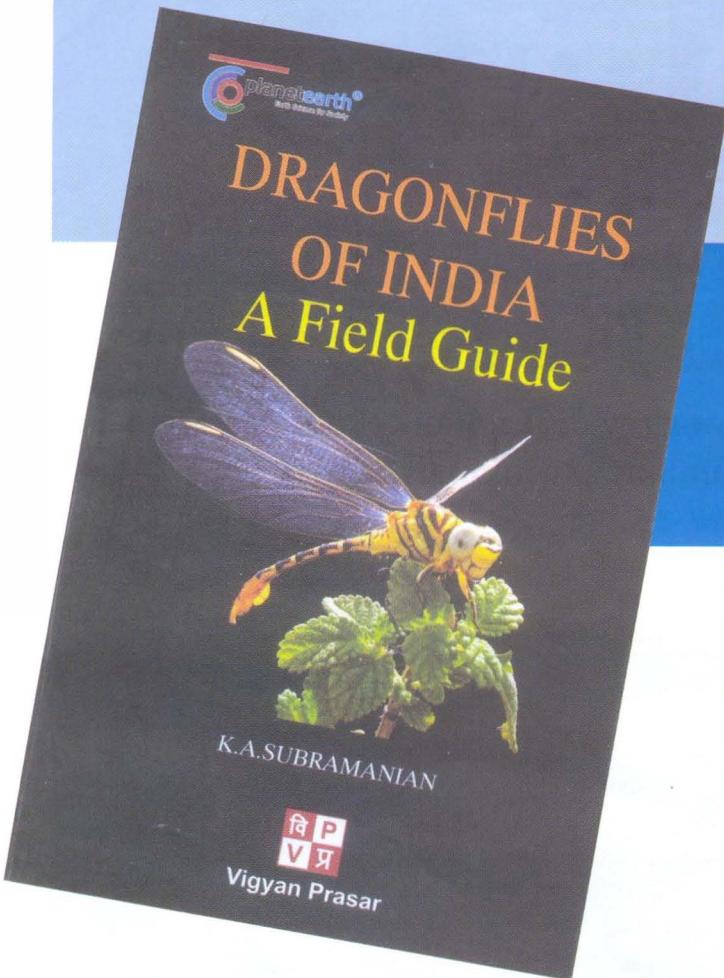
SCIENTIFIC INSTRUMENTS SEARCH

RAINGAUGE	PERSCOPE	THERMOSTAT
ESCALATOR	SEXTANT	PLANIMETER
SPHEROMETER	CLOCK	WIRELESS
STROBOSCOPE	TELESCOPE	MICROPHONE
MOTOR	RADAR	TELEVISION
DYNAMO	COMPUTER	TELEPRINTER
TAPE RECORDER		GALVANOMETER
SHYGMOMANOMETER		HYGROMETER

THE NAMES OF THE PRIZEWINNERS ARE AS FOLLOWS:

1. **Mohammad Aqib Alam,**
S/o Mohammad Nazre Alam,
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Jharkhand-834002
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CONGRATULATIONS ALL THE WINNERS!



Dragonflies and Damselflies (together known as Odonates) date back to the Carboniferous era, about 250 million years ago. In fact, odonates are primarily aquatic insects and their life history is linked to specific aquatic habitats and so these creatures are also in a way good indicators of wetland health.

India with its geographically diverse climatic regions support rich odonata fauna. However, it is a matter of grave concern that there is no comprehensive record or documentation of Indian Odonates after Fraser's *The Fauna of British India-Odonata* (1933-36), which in its three volumes depicts and describes 536 species and sub-species within the Indian region.

The IUCN Red Data Book (International Union for Conservation of Nature-2004) lists certain species i.e. *Burmagomphus svallkensis*, *Cephalaeschna acutifrons* and *Epiophlebia laidlawi* as threatened Indian odonates. All these three species are found in the Northeast part of India. The major reason for extinction is large-scale habitat decimation. It is a known fact that odonate species inhabiting in agroecosystems play a vital role in controlling the insect pest population, which is a perpetual and haunting problem for a country like India.

Vigyan Prasar has recently published a field guide on Dragonflies and Damselflies. The book carries photographs of 111 species of Indian Dragonflies and Damselflies for accurate

Nature's Delight

DRAGONFLIES OF INDIA: A FIELD GUIDE

by K.A. Subramanian,
published by Vigyan Prasar, A-50, Institutional Area,
Sector-62, NOIDA-201309, U.P.;
Ph.: 0120-2404430,31,35,36;
Pages: 168; Price:
Rs.125/- ISBN No.: 978-81-7480-192-0

The book underlines the necessity of studying the creatures. The author also gives useful tips on where, when and how to watch these wonderful and useful odonates.

and quick identification. Moreover, the author has painstakingly provided English common names of these Indian creatures. To evoke the curiosity of readers, concise text has been elaborated on key characteristics and ecology of each species.

The publication is an offshoot of a project called Project Lifescape of the Centre for Ecological Sciences, Indian Institute of Science and Indian Academy of Science, Bangalore. On an earlier occasion, an E-Book on Dragonflies and Damselflies of the peninsular India was launched. The encouraging response to the E-Book has now resulted in a hard copy book.

Many Indian Odonates are endemic and most of them are found around riverine ecosystems. The book underlines the necessity to study these creatures. The author also gives useful tips on where, when and how to watch these wonderful and useful odonates (for instance, a practical tip he gives is that one should wear dull coloured clothes and move stealthily to watch these shy creatures!

Large-scale habitat changes such as damming, channel diversion, sand mining and pollution are the contributing factors for decimation of the odonates species. As the author emphasizes, there is a need for massive efforts to conserve and protect these species of odonates. There is also a need for devising and implementing apt national level policy and specific fresh water biodiversity conservation programmes.

This field guide is definitely a gift for nature lovers, students and teachers of High School and Under Graduate level.

Reviewed by Mr Suryakant Sharma, Flat No.101 (FF), H2/21,Bengali Colony, Mahavir Enclave, Palam, New Delhi-110045;
Email: suryakant_sharma03@yahoo.co.in

Lantana A Menace or Friend?

Reviled as a nuisance and a menace worldwide, Lantana can surprisingly be of great help to humans and animals.

How could a plant, well known as a menace worldwide, be even remotely thought of as being environment friendly? Even though *Lantana* spreads rapidly everywhere ruining the habitats of some plants and choking others, it does have a role to play in protecting our health, generating wealth and even conserving our environment.

Lantana Linn., a genus of herbs and undershrubs or shrubs, belongs to the family Verbenaceae. It has a characteristic aromatic smell and quadrangular, pale green, hairy stem. It bears small, 20-30 multi-coloured flowers on every branch throughout the year. The fruit of the shrub is a berry – green or blue-black in colour. About seven species, reported from India, have adapted to the harsh conditions in tropical and subtropical parts. *Lantana camara* Linn., a native to tropical and subtropical America, is the most common species in India where it is known as Lantana, Red or Wild sage, *Ghaneri* in Marathi and *Raimuniya* in Madhya Pradesh.

Lantana possesses several qualities that could be of immense benefit to humans and animals. It can provide shelter to wild organisms. As a source of wood it can fulfill our day-to-day requirements. It possesses healing properties that can fight and cure many ailments. It can provide raw material for paper pulp, biomass for electricity generation and also manure. It plays a significant role in crop protection as it has insecticidal properties.

The lantana flowers attract a wide variety of beautiful butterflies





Lantana attracts a large number of birds

This species has the quality to bear and to survive at high temperatures and hence could even adjust well to the ill effects of global warming. It also grows very rapidly.

Origin in India

Lantana (from the Latin *lento*, to bend) probably derived from the ancient Latin name of the genus *Viburnum*, resembling it in foliage and inflorescence. The genus has seven species in India including both herbaceous plants and shrubs with 0.5-2 m (1.6-6.6 ft) height and is said to be a native of Tropical America. In India, it was introduced in 1809 (Calcutta Botanical Garden), as an ornamental plant due to its beautiful aromatic flowers. It was then confined largely to hedges but now is widespread, particularly in dry to moist deciduous forests.

Protector of Biodiversity

Environmentally, this plant acts as a saviour of many animal and insect species like butterflies that are at the verge of getting extinct. With its vivid colors and arrangement of nectar-filled flowers, it is attractive and serves as a primary food source for them. The major visitors to these plants are Painted lady (*Vanessa cardui*), Common buckeye (*Junonia coenia*), Western Tiger swallow tail (*Papilio rutulus*), Gulf fritillary (*Agraulis vanilla*) and Pipevine swallow tail (*Battus philenor*). The majority of them can be seen wherever Lantana

is present, creating a pleasant scenic view.

The juicy pericarp of Lantana attracts a large number of dispersal agents such as birds. Around 18 species, including some common birds like Red-vented bulbul (*Pycnonotus cafer*), Magpie robin (*Copsychm saularis*), Common myna (*Acridotheres tristis*) and Indian cuckoo (*Cuculus micropterus*) have been identified.

It is reported that, the density of Bulbul increases with increase in Lantana in moist and dry deciduous forests and thus acts as an indicator of habitat change.

Lantana also helps to cope with one of the most troublesome weeds in the world, Water hyacinth (*Eichhornia crassipes* Solms), by suppressing the emergence of its leaf buds. A foliar extract spray of Lantana causes its leaf to decay. On the other hand, the crude aqueous extract of fresh fruits of Lantana on wheat plants at 100% concentration has shown a growth-promoting effect. It holds potential to be used as a substitute for growth-promoting synthetic chemicals.

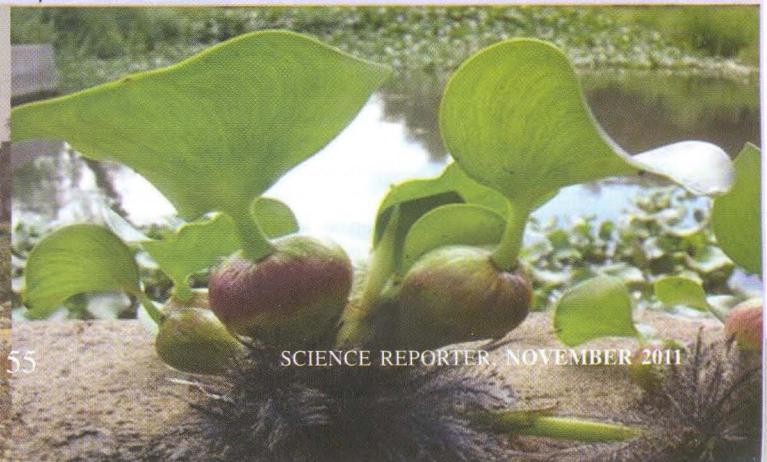
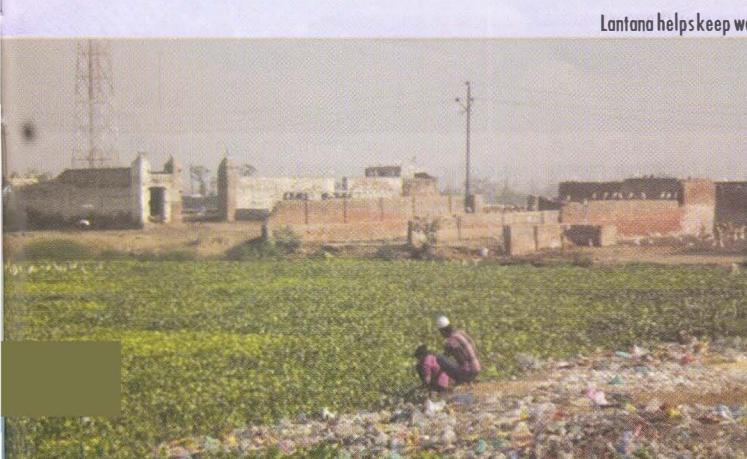
It is a useful exotic as it provides shelter to many wild animals. It is used as a protective hedge to keep roaming animals out of one's property and is planted on rocky hillsides to prevent erosion. It also improves the fertility of rocky, hard laterite soils, serves to retain humus in deforested areas and can withstand major problems like infertile, alkaline soils due to its salt-

Lantana possesses several qualities that could be of immense benefit to humans and animals. It can provide shelter to wild organisms. As a source of wood it can fulfill our day-to-day requirements.



Tigers and leopard taking rest in the Lantana bushes

Lantana helps keep water hyacinth under control



The Lantana plant has numerous and rare qualities, comparable to other plants, and hence must be harnessed and also explored for its revenue generation potential.

Lantana sticks being prepared for making products (right)

tolerant property. Due to this property, it has opened the doors for rejuvenation of exploited, deforested and barren lands and converting them into flourishing ones.

Treasure of Economic Values

Lantana is of great economic value too. Here's how.

Wood articles: Lantana has proved to be a good source of wood for making furniture that is as good as those of cane wood. It is thus of great value as it helps saving the valuable trees that are being recklessly cut down for this purpose. Villagers and tribals have come out with a galaxy of beautiful, useful, comfortable and durable household articles like sofa, chair, bee-keeping boxes, fish-catchers and many other items for domestic use as well as for selling them in the open market and thus earning their livelihood.

Hangers for clothes made from Lantana wood can easily replace those traditional iron and plastic ones and are comparatively durable. Various attractive art-pieces are also made and many can be designed, marking its presence in handicraft market.

Biofuel and Bioethanol: Lantana wood is an efficient fuel wood as it catches fire easily and has a good calorific value. Biomass works as a major raw material in electricity generation. Its leaf litter can be converted into charcoal using the carbonization process.

Lantana camara contains hemicelluloses (a group of complex carbohydrates), and hence, can serve as a low-cost feedstock for bioethanol production after saccharification and fermentation.

Paper pulp: Lantana is almost treated like bamboo and can provide raw material for paper pulp. The chemical composition of Lantana is 75.03% hollocellulose, 8.461% extractive, 18.21% lignin and 2.31% silica, indicating its potential use as a material to provide strength in the preparation of polymer matrix composites.



Manure: Biomass from the Lantana plant is used in manuring coconut trees from its ash, which contains a good amount of potassium and manganese and the twigs as green mulch in crop fields. It has proved to be useful as an organic source for improving soil productivity under rice-

wheat cropping and saved chemical nitrogenous fertilizer by 50%. Lantana has been found to improve soil fertility and soil quality, accelerate N and P cycles, utilize carbon substrates more effectively, and has higher functional diversity.



Good source
of wood for
making
furniture

SOME MORE USES OF LANTANA

- Serves to nurse parasitic sandalwood seedlings and as a support for yam vines.
- The scabrous leaves can be used in place of sandpaper to polish wood.
- The easy availability of the withered leaves of this common weed can make it a cheaper enzyme (Alkaline protease) source and potential additive in detergents.
- Lantana leaves and fruits are edible. Its young leaves mixed with salt are eaten to stimulate digestion and ripe fruits are eaten in many remote and underdeveloped areas. The nutritional composition of its seeds suggested that they could be used to meet part of the nutritional requirements of animal feeds. Also, they could be regarded as good source of food ingredients and as new source of edible oils.
- Lantana flowers, abundantly available, have been used to extract an eco-friendly natural coloured dye for silk.
- One of the beneficial properties of Lantana is its acclimatization against harsh climatic conditions, pests and diseases. Its drought resistance and seed germinability even after exposure to 80°C has made this species the best woody species that has the potential for mitigation of salinity and global warming. Fast growing Lantana can be grown for land reclamation process due to its productivity and climate tolerance.

Medicinal value: Medically, this plant has shown marvelous results as it can be used in various ailments like cold, fever, influenza, stomachache, hypertension, rheumatism, asthma, high blood pressure and diarrhoea. If applied externally, it provides relief in measles, chicken pox, snakebites, cuts, eczema, bruises and is also used to remove worms from the stomach. It has been claimed that a steroid lannamarone extracted from the leaves exhibits cardiotonic (strengthening the heart) properties.

An alkaloid, lantamine, present in the shrub can cure fever and prevents muscles from sudden contraction, comparable to quinine. The methanolic extract of *Lantana camara* leaves shows healing of gastric ulcers and also prevents development of duodenal ulcers in rats. The extract of the plants has shown excellent topical antifungal property for the cure of tinea and ringworm in rats. It has also been found effective in healing

excision wounds in experimental animal and could be evaluated as a therapeutic agent in tissue repair processes associated with skin injuries.

It is considered good for healing wounds, inducing perspiration and curing flatulence. It is also used in treatment of pustules, fistulae, tumors, tetanus, malaria and other abdominal problems. Chloroform and methanol extracts of the plant showed presence of active principles against *Mycobacteria tuberculosis*, which merits further research on applications of this invasive weed to cure tuberculosis. Recently, natural products from Lantana have been implicated in the prevention and cure of many serious diseases including cancers.

Antifungal, Insecticidal and Antibacterial: Lantana is also reported to show antifungal, antibacterial and antiaflatoxigenic effects against various microorganisms like *Aspergillus flavus* (key storage fungi), *Pseudomonas aeruginosa*

The Lantana plant also displays pesticidal effect and has shown promise as a natural preservative without affecting the colour and odour of grain.

(Gram-negative bacteria), *Staphylococcus aureus*, *Bacillus cereus*, *Cladosporium sphaerospermum*, *Fusarium solani*, *Rhizoctonia solani*, *Meloidogyne javanica* and *Mycobacterium* which causes tuberculosis.

An exciting and important feature of this plant is that in the Himalayas Lantana is formed into incense cakes that are used as mosquito repellent. Besides, it has been exploited as a potential insecticidal against *Aedes aegypti* and *Culex quinquefasciatus* IVth instar mosquito larvae, which points towards its use as an eco-friendly insecticide. The root extracts showed potential to kill mosquitoes. The leaf extract of *Lantana camara* significantly controlled *Bemisia tabaci* as compared to chemical insecticides.

In addition to all these properties, it also displays pesticidal effect and has shown promise as a natural preservative without affecting the colour and odour of grain. The plant also possesses termicidal activity. Research reports have concluded that fresh-cut lantana leaves, stems and flowers could be used as additives to garden mulches against termites. An experimental study conducted on the nematicidal potential of the aerial parts against root-knot nematode *Meloidogyne incognita* revealed better activity than conventional nematicide furadan (100% mortality at 1 mg/ml concentration after 24 h).

Lantana is widely considered as a poisonous weed due to its rapid spread, disturbing the native vegetation, animal habitats and biodiversity, and is regularly eradicated because it is perceived to be useless. But the plant has numerous and rare qualities, comparable to other plants, and hence must be harnessed and also explored for its revenue generation potential.

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Email: nidhiwoi@niscair.res.in

ANIMALS WITH PLANTLIKE NAMES

MAYANGLAMBAM OJIT KUMAR SINGH

1. This gastropod (*Pila globosa*), which is moderately amphibious and a popular aquarium pet, is also called:

- a) Apple snail
- b) Mango snail
- c) Orange snail
- d) Pumpkin snail



4. Crab spiders of the genus *Misumena* can change their colour between white and yellow to match the flower they are sitting on and are commonly known as:

- a) Nectar crab spider
- b) Flower crab spiders
- c) Fruit crab spider
- d) Inflorescence crab spider

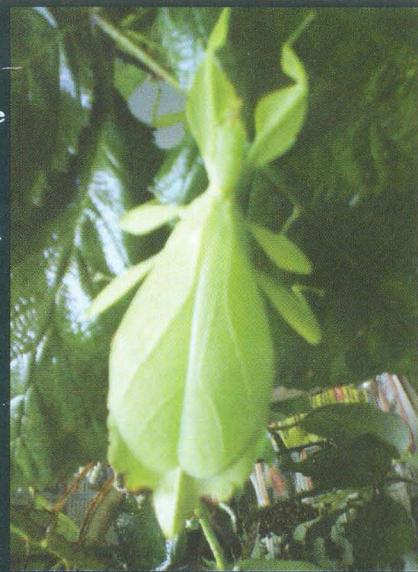


2. This crab (*Birgus latro*), the largest land-living arthropod in the world, is also called:

- a) Coconut crab
- b) Palm thief
- c) Robber crab
- d) All the above

5. True leaf insects that belong to the family Phyllidae are some of the most remarkable leaf mimics in the entire animal kingdom. These leaf insects are also called:

- a) Jumping leaves
- b) Climbing leaves
- c) Walking leaves
- d) Flying leaves



3. The Peacock flounder (*Bothus mancus*) is a species of fish in the family Bothidae (lefteye flounders) also known as:

- a) The Flowery flounder
- b) The fruity flounder
- c) The seedling flounder
- d) The leafy flounder



6. *Litoria chloris* is a species of tree frog native to eastern Australia and is also commonly known as:

- a) The Red-eyed Tree Frog
- b) The Golden-eyed Grass Frog
- c) The Red-eyed Pine Frog
- d) The Golden-eyed Banana Frog

FUN QUIZ

7. The Ectoprocta (also known as Bryozoa) are commonly known as:

- a) Mushroom animals
- b) Root hair animals
- c) Moss animals
- d) None



8. The Sipuncula or Sipunculida is a bilaterally symmetrical, unsegmented marine worm also known as:

- a) Peanut worm
- b) Jamun worm
- c) Creamy ladies finger worm
- d) Rock gardener



9. Littorina is a genus of small sea snails that live in the tidal zone of rocky shores. Littorina is commonly known as:

- a) Plum
- b) Rambutan
- c) Apricot
- d) Periwinkle



10. Echinoderms belonging to the class Holothuroidea are commonly referred to as:

- a) Sea brinjals
- b) Sea bottle gourds
- c) Sea cucumbers
- d) Sea eggplants



11. Crinoids, which in their adult forms are attached to the sea bottom by a stalk, are commonly known as:

- a) Sea lilies
- b) Sea lotuses
- c) Sea mushroom
- d) Sea roses



12. Renilla is an anthozoan that is strikingly bioluminescent when disturbed, due to Green Fluorescent Protein. The common name of Renilla is:

- a) The sea cucumber
- b) The Sea fucus
- c) The Sea Pansy
- d) The Sea gourd



13. The warty comb jelly (*Mnemiopsis leidyi*) is a species of tentaculate ctenophore (comb jelly), originally native to the western Atlantic coastwaters and is also called:

- a) Sea walnut
- b) Sea Peanut
- c) Sea Hazelnuts
- d) Sea chestnut



14. *Euplectella aspergillum* in the phylum Porifera in a dead, dry state is given as a wedding gift because the sponge symbiotically houses two small shrimps, a male and a female, who live out their lives inside the sponge. It is also called:

- a) The Mar's Flower basket
- b) The Venus' Flower basket
- c) The Earth's flower basket
- d) The Jupiter's Flower basket



15. A loosely-applied common name for a group of medium-sized to large shell-less colorful sea slugs or nudibranchs, specifically dorid nudibranchs in the family Dorididae, is:

- a) Sea Papaya
- b) Sea Banana
- c) Sea Lemon
- d) Sea Orange



ANSWERS:

- 1. a 2. d 3. a 4. b 5. c 6. a 7. c 8. a 9. d 10. c
- 11. a 12. c 13. a 14. b 15. c

Contributed by Mayanglambam Ojit Kumar Singh, Assistant Professor in Zoology, Ramjas College, Maurice Nagar, University Enclave, Delhi University, Delhi-110007; Email: ojit102005@yahoo.co.in

Australopithecus sediba:

Serendipitously Ours

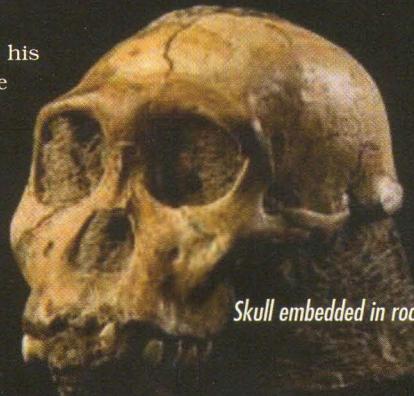
Death came for this young male much before his time. He was aged somewhere between nine to thirteen years...too young to die. No one knows if anyone saw him die or even how he died. No eyewitnesses have survived. No records exist of his final resting place. History appeared to have passed him by.... until 15 August 2008, when his bones were liberated from the confines of the soil by Mathew Berger, another nine year old. The place was the Cradle of Humankind, a UNESCO World Heritage site near Johannesburg.

Mathew Berger (and Tau, his dog) were dashing around excitedly when he tripped over a log and got up waving a clavicle or collar bone. "Dad, I found a fossil!" Matthew shouted out to his father, Lee R. Berger, a paleoanthropologist with the Institute for Human Evolution at the University of the Witwatersrand in Johannesburg, South Africa. Dad was searching for fossils nearby and he ran towards his son. When within viewing distance, Dr. Berger was stunned by the fact that the 'bone' his son was waving around was a "...clavicle with the unmistakable shape of a hominid."

The story did not end there. In March 2009, Dr Berger found a remarkably intact cranium to go with the clavicle. A second partial skeleton of an adult female was also found close to where Mathew found the first bones. Scientists speculate it might have been a mother and son team out on a hunting trip. It took a team of more than 60 scientists and a large contingent of students more than a year-and-a-half to extract the bones from the rock. Dating techniques placed the age of the rocks encasing the bones to between 1.95 and 1.78 million years.

The fossils are, "...a surprising and distinctive mixture of primitive and advanced anatomy and thus qualified as a new species of hominid, the ancestors and other close relatives of humans." The new species was named *Australopithecus sediba*. The species name "sediba" means natural spring, fountain or wellspring in Sotho language. It also ties in with the fact that these were discovered in an eroded cave believed to have been an underground lake. The fossilized animal bones that were recovered alongside included those from a sabre-toothed cat, antelope, mice and rabbits. None of the animals appear to have been eaten by scavengers. This indicates that all died suddenly and were swiftly entombed.

"We think that there must have been some sort of calamity taking place at the time that caused all of these fossils to come down together into the cave where they got trapped and ultimately buried," says Professor Paul Dirks from James



Skull embedded in rock



Cook University in Queensland, Australia. All the bones were preserved in the hard calcified sediment that formed at the bottom of a pool of water.

Today, the boy *Australopithecus sediba* is better known as Karabo. In the Setswana language the word Karabo means "answer". It was one of the more than 15000 submissions in a naming competition sponsored by Standard Bank and Palaeontological Scientific (PAST) in association with Witwatersrand University, Johannesburg and the Department of Science and Technology.

The name was proposed by 17-year-old Omphemetse Keepile, a student of St. Mary's, Johannesburg. Omphemetse says that she chose the name Karabo because "...it suggests that answers are present [and] that more answers will follow." She explained that the fossil represents a "solution" to understanding the origins of humankind.

Karabo walked upright on long legs, had a prominent nose, and human-like hips and pelvis. However, he could climb trees using his ape-like arms. He had small teeth and yet his face resembled that of *Homo*, the genus that includes us modern humans. He had relatively primitive feet and the "tiny brain" that is common to *Australopithecus*. Dr. Berger's team said that the new species probably descended from *Australopithecus africanus*. Dr. Berger described the species as, "... a possible ancestor of *Homo erectus*, an immediate predecessor to *Homo sapiens*, or a close 'side branch' that did not lead to modern humans."

Since the find is such a recent one, studies are still on. The precise placement of *A. sediba* in the human family tree is becoming a little controversial; some opine that it may well be a *Homo*. "They are a fascinating mosaic of features," says Rick Potts, director of the Human Origins Program at the Smithsonian Institute. "It reminds us of the combining and recombining of characteristics, the tinkering and experimentation, that go on in evolution."

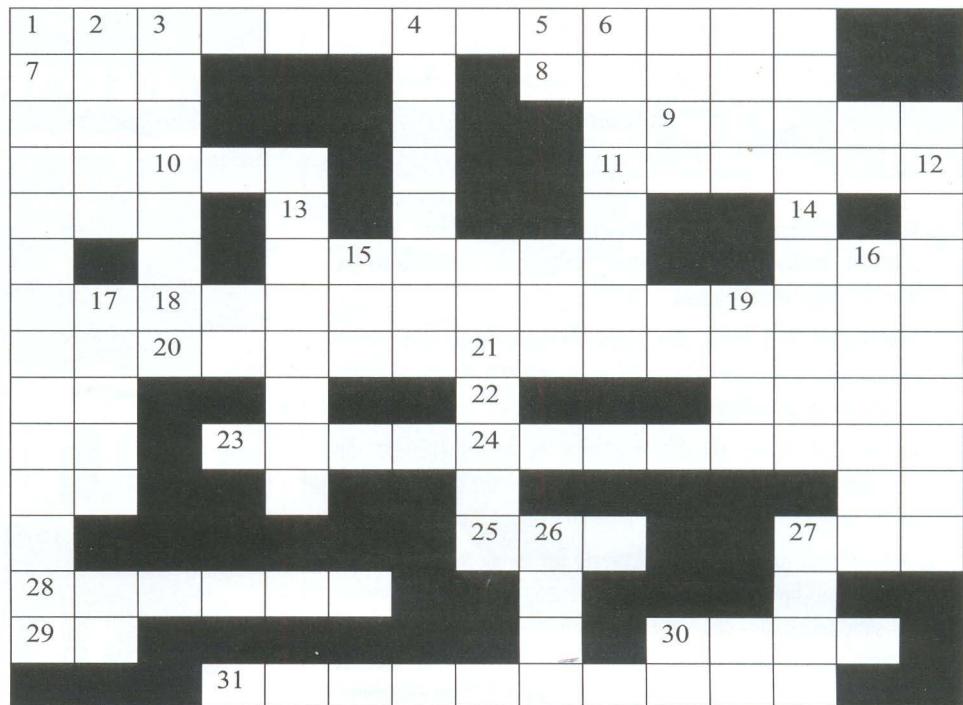
Dr Sukanya Datta, Scientist NISCAIR posted to Director General's Technical Cell, CSIR HQ, Email: sukanya@csir.res.in

ACROSS

1. This group of invertebrates is found only in seawater (13)
8. Type of feather of birds (5)
9. A unit of radioactivity (5)
10. Polymerase chain reaction (3)
11. External ear lobe (5)
15. Positive electrode (5)
18. Beetles are included in this order of Insecta (10)
20. Enzyme linked immunosorbent assay (5)
21. Nocturnal lepidopteran pest (4)
23. Solitary social insect (4)
24. Fertilizer found in wine (4)
25. Shortened form of variable region to L&H chains of antibody (3)
28. Milk curdled by the action of cultures (6)
29. Graft between two different genera (9)
30. Fermented grape juice (4)
31. A device for separating components of a suspension by spinning (10)

DOWN

2. Group of cells derived from a single cell (5)
3. Virus that affects the nervous system and causes burning sensation in the skin (6)
4. Author of atomic theory (6)
5. Respiratory Quotient (2)
6. Virus disease that affects parotid gland
7. Fossil bird having reptilian and avian features (13)
12. Technology used in production of monoclonal antibody (10)
13. Bill of this bird can hold more than its belly (7)
14. Triangular bone forming lower extremity of spinal cord (6)
16. Female anopheles mosquito is the vector for this fever (7)



17. One of the ear ossicles (5)
19. Generic name of Honey bee (4)
22. Another name for Balbiani ring of giant chromosome (4)
26. Formic acid can be prepared from this insect (3)
27. Unit of force used in c.g.s system (4)

Contributed by Dr K. Venkataraman, AT2 Porkudam apartments, Bypass Road, Madurai-10

SOLUTIONS TO SEPTEMBER CROSSWORD